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# SURGERY, GYNECOLOGY AND OBSTETRICS

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## PYCLOGRAPHY AND CHOLECYSTOGRAPHY AS AIDS IN THE DIFFERENTIATION OF SHADOWS DUE TO RENAL OR BILIARY CALCULI<sup>1</sup>

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ONE encounters, from time to time, cases in which the clinical history and objective findings point equally as much to biliary tract as to right kidney infection. If, on radiographic examination, shadows are visible over the right upper abdominal quadrant the question at once presents itself as to whether these shadows are due to biliary calculi or to renal calculi, or perhaps to the presence of both.

### HISTORY

Before the routine employment of pyclography by urologists and the discovery of cholecystography by Graham and Cole in 1924 both radiologist and clinician were obliged to depend on data which, we will attempt to show, are very unreliable.

In 1917 Lewis G. Cole summarized the chief points of differentiation between shadows due to biliary and those due to renal calculi as follows:

Renal calculi	Biliary calculi
Usually single shadow	Usually multiple shadows
Shadows of uniform density	Either dense nucleus or ring like shadows
Shadows seldom change position during examination	Frequently change position
Shadows are rounded	Shadows usually faceted or flat
Often branching shadows	Never branching
Shadows vary in size if multiple	Same size and shape if multiple

B. H. Nichols a little later, emphasizes some of these points of differentiation. He states that biliary calculi are round, with a center of lesser density, while renal calculi are more commonly oblong and of uniform density.

Young and Waters in their recent book, direct attention to one of the distinguishing features of biliary calculous shadows as being the presence of centers of lesser density with concentric ringlike formations around such lighter centers. These authors emphasize the advisability of taking lateral views to ascertain if the shadows are extrabiliary (provided that they have been previously included in a cholecystogram).

Braasch and Hager state that the majority of biliary calculi have an accentuated cortex and an indistinct center. According to these authors, biliary calculi are more or less circular and often are seen in clusters or groups. They may, however, assume a great variety of shapes and characters, so as to simulate closely the shadows of renal calculi. They point out the fact to which we also direct attention later, that in some cases the shadows of both biliary and renal calculi may be identical in location and character.

Our interest in the question of whether one is able to distinguish the shadows of biliary from those of renal calculi was aroused by a

case published by us in 1927. In this patient it was comparatively easy, with the aid of cholecystography, to state definitely that the shadow in the right kidney region (Fig. 1) was of renal origin. The shadow was triangular in shape and of uniform density.

Shortly afterward a second case presented itself with symptoms pointing to both gall bladder and right kidney infection. Over the lower pole of the quite distinct renal shadow was a uniformly dense round, small shadow (Fig. 2, A) which one of us felt confident to be of renal origin. In order to ascertain its exact character, a cholecystogram was made. This revealed the shadow to be the calcified center (Fig. 2, B) of a relatively large biliary calculus, which was removed later.

Inspection of films in similar cases led us to study the following aspects of the subject:

1. Is the location of a shadow of any assistance in the differentiation of biliary and renal calculi?

2. Can one place any reliance in the above differentiation on the number, the density, form, or change in position of the shadows?

3. Of how much value are cholecystography or pyelography or a combination of the two in such a differentiation?

4. What other shadows must be taken into consideration?

We will take these up in the order named.

#### I. IS THE LOCATION OF A SHADOW OF ANY ASSISTANCE?

With improved radiographic technique, it is usually possible to visualize the shadows of one or both kidneys on a plain film, unless the patient is very obese or there is too great an accumulation of gas in the colon. The pelvis of the right kidney, as seen on such films, is either located opposite the interspace between the right transverse processes of the first and second lumbar vertebrae (Fig. 3) or a little lower, i. e., in the corresponding space between the second and third lumbar vertebrae (Fig. 4).

When, as often occurs, the right hepatic lobe is also visualized, one is impressed with the degree of overlapping of the upper pole or even upper half of the right kidney (Fig. 4) by the right lobe of the liver and gall bladder. We

mention these perhaps familiar anatomical relations because it enables one to understand why a question should at times arise as to whether a shadow is in the gall bladder, or in the renal pelvis proper, or in one of the calyces of the right kidney.

At times the gall bladder may be directly over the hilus of the kidney. A shadow such as the one shown in Figure 5 might be interpreted as of renal origin from its location, until either cholecystography (Fig. 5) or pyelography are carried out to determine the exact nature of the shadow.

In patients with generalized visceroptosis the liver (Fig. 6) the gall bladder and both kidneys are usually at a lower level than normal. In abnormal mobility of the right kidney (Fig. 7) the shadow of a renal calculus is at a lower level, but that of the gall bladder, when visualized by cholecystography, lies usually well above that of the kidney. Under either of the above two conditions, a biliary (Fig. 10, C) or a renal calculus may lie very low.

The rapid strides in urologic diagnosis in which pyelography has played an important part have enabled us to interpret shadows seen at unusual locations to be due to calculi lying within the pelvis of a horseshoe kidney (Fig. 8) or similar anomalies. Hence, it will be evident that the location of a shadow is not pathognomonic for either a biliary or renal calculus. In a few cases, such as the one shown in Figure 9, the shape, density, and also the location of the shadows appear too high for those of renal calculi.

If shadows are seen during fluoroscopic examination, one can occasionally decide whether they are of renal or biliary origin by the rotation method. This consists in the turning of the patient toward the left or right, the spine being used as an axis. In this way one is able to ascertain whether the suspected calculous shadow lies in an anterior or a posterior frontal plane. If, however, the suspected biliary calculus lies in the same plane as the kidney, this rotation method is of no value.

One can therefore make the deduction in our opinion that with but few exceptions the location alone of a given shadow is of little help in the differentiation of a biliary from a renal calculus.

- 2 CAN ONE PLACE ANY RELIANCE IN SUCH A DIFFERENTIATION UPON THE NUMBER, THE DENSITY, THE FORM, OR CHANGE IN POSITION OF THE SHADOWS?

Let us consider these items separately

*The number of shadows* Although one is more apt to encounter multiple small shadows in biliary lithiasis, such as are shown in Figure 11, similar multiple small shadows have been encountered in cases of renal calculi by Graham and ourselves

If there are multiple somewhat larger shadows like those seen in Figure 9 lying over the renobiliary region, one can usually decide that they are of biliary origin if the shadows are faceted and present the alternation in density (light center and dark periphery or vice versa) which is so often seen in biliary calculi (Fig 12)

In one of our recent cases, in which there were symptoms and definite findings indicative of a right pyelitis, multiple small shadows were to be seen (Fig 13, A) over the mesial portion of the right kidney. We felt that such a location of renal calculi would be very unusual (unless the calculi were in a dilated calyx). In order to be thorough, cholecystography was resorted to. This confirmed our suspicion that the calculi were in the gall bladder (Fig 13, B)

We have encountered a case of multiple, irregular, relatively large shadows with light centers and darker edges over the renal region which were difficult to interpret until, at operation, multiple calculi were found in a tuberculous kidney. Although this occurred on the left side (Fig 14), it might just as easily be found over the renobiliary region

*The density, i.e. the opacity of the shadows* The older view, that the density of the shadow due to a biliary or urinary calculus depends entirely upon the atomic weight of its constituents is being discarded. H. P. Kleinschmidt, White, D. E. Shea, and Karris have made valuable contributions to the question of chemical composition and structure of renal calculi in relation to radiography. The generally accepted view is that the density of the shadow, i.e., the opacity of a renal calculus depends on (a) the atomic weight of its constituents, (b) its structure, and (c) its thick-



Fig. 1. Although the urologist was confident that the shadow A seen over the right kidney region could explain the colic like attacks and pyuria in this patient, the attending physician was of the opinion that the shadow was due to a biliary calculus. Although the shadow seems to be included in that of the cholecystogram B, an exposure at a different angle and a lateral view soon demonstrated its extrabiliary nature. This case and those shown in Figures 1 and 14 illustrate the value of exposures at different angles and of lateral views in doubtful cases.

ness. Kleinschmidt has proposed a division of renal calculi into soft and hard. Even those whose constituents are of heavy atomic weight (see accompanying table) may be permeable to the X ray if they are very soft. In order to understand this question of soft and hard calculi, one must be able to visualize the formation of a calculus. Into the colloidal framework are deposited the crystals of the various constituents (Fig 15) of urinary calculi. Those composed of chemical combinations of heavy atomic weight, as in the accompanying table, would, *a priori*, be expected to give the densest shadows.



Fig 2 In this patient there were symptoms of infection of the right kidney and also of the biliary tract. A small shadow of uniform density *A* was seen over the lower half of the right kidney. A cholecystogram showed that this shadow was the nucleus of a biliary calculus. After removal of the calculus from the gall bladder it was placed on a radiographic film. Only this more dense central portion yielded a shadow.

#### COMPONENTS OF URINARY CALCULI (FROM SHEA'S ARTICLE)

Hydrogen	1	Magnesium	24
Carbon	12	Phosphorus	31
Nitrogen	14	Sulphur	32
Oxygen	16	Potassium	39
Sodium	23	Calcium	40

One can visualize, however, that if the coloidal mesh is loosely constructed and the

crystalloids, consequently, deposited at relatively wide intervals the opacity of such a calculus would be proportionately less.



Fig 3 Plain roentgenogram of right upper abdominal quadrant. The shadow of the right kidney has been outlined. Note location of renal hilus opposite space between right transverse processes of first and second lumbar vertebrae (compare with Figure 4).



Fig 4 Plain roentgenogram of right upper abdominal quadrant with lower and lateral borders of right lobe of liver, of gall bladder, and two-thirds of right kidney outlined in white. Note relation of gall bladder to upper half of the kidney. In this patient the right kidney was at a slightly lower level than in the one shown in Figure 3 so that the renal hilus lies opposite space between right transverse processes of second and third lumbar vertebrae. This position of the right kidney as well as the position shown in Figure 3 may be considered as within the normal range.



Fig 5 Relatively large biliary calculus of uniform density lying directly over hilum of right kidney. Cholecystography revealed the biliary character of the shadow. The edges of the gall bladder shadow and those of the right kidney were outlined in white. They were to be seen distinctly in the original film but were too faint to be reproduced in an illustration. (Courtesy Dr S Strouse and Dr Binswanger.)



Fig 6 Location of right lobe of liver and of right kidney in a case of generalized visceroptosis. Note lower position of both kidneys as compared to lower position of right one alone in case of abnormal mobility of this organ (Fig 4). In both patients bilateral pyelograms were made.

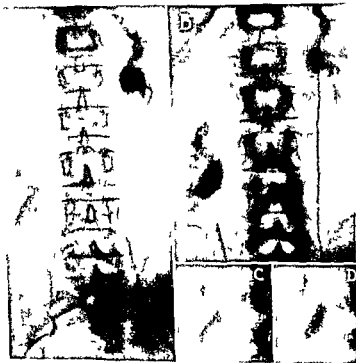


Fig 7

Fig 7 Serial exposures in case of dropped right kidney. A Note low position of right kidney as compared to that of the left. B same before withdrawal of opaque catheter. C 8 minutes after withdrawal of catheter. D 20 minutes after.



Fig 8

Fig 8 Typical location of a calculus shadow close to median line lying in right half of horseshoe kidney. This can occur only when the corresponding half lies close to the median line which is not always true of one or both halves of a horseshoe kidney.



Fig 9 Shadows of two biliary calculi with dark centers and edges lying much higher than would be the case in those of renal calculi. Such cases do not require pyelographic study (Courtesy of Dr S Strouse)

A similar deduction may be made as to the relation of the thickness of a calculus to its opacity.

One finds somewhat less complicated conditions as to chemical composition in biliary calculi. Graham divides them into three groups (a) the cholesterol (b) the bilirubin calcium, and (c) the rarer form (imperfectly crystallized and calcium carbonate). Cholesterol, which has a relatively slight X ray opacity, forms the chief part of most biliary calculi.

It has been estimated that about 10 to 12 per cent of urinary and about 90 per cent of biliary calculi are permeable to the X ray, i e., do not yield a shadow. In the case of biliary calculi, this larger percentage is the result of the greater permeability of their chief constituent, cholesterol. For this reason plain radiography has been found of comparatively little value in biliary lithiasis. We shall refer to this later in speaking of the value of cholecystography and ureteropyelography in visualizing, respectively, non-opaque biliary and renal calculi.

We thought it might be of interest to compare the opacity of biliary and renal calculi placed on plain radiographic films. A glance at Figures 16 to 21 inclusive shows the result of this study to be as follows:

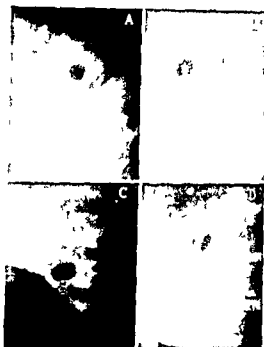


Fig 10 Shadows in four cases of biliary calculi. A Calculus with dark center and light periphery. B calculus with light center and dark periphery. C biliary calculus located close to crest of ilium in low lying gall bladder. D shadow of calculus in the common duct.

Figure 16 shows relatively large renal calculi. Fourteen of the sixteen calculi yield a uniformly dense shadow. The calculus marked 5, is a confirmation of what has been said previously as to the opacity of a calculus not only being dependent on the chemical composition but also upon its structure and thickness. At one edge, the structure is quite compact and the resultant shadow quite dark. In the remainder of the calculus (best seen with a magnifying glass) the structure is quite loose and the opacity very faint. These differences in structure are also visible to a less marked degree in the calculi shown as Nos 1, 3, 7, 10, 12 and 13. Calculus 15 would be practically non opaque if the film were made clinically with the calculus in a kidney.

Figure 17 shows small renal and ureteral calculi. One notes the same variation in density as in the preceding figure. None of the calculi fail completely to yield a shadow. Calculus 3 is of interest in connection with the

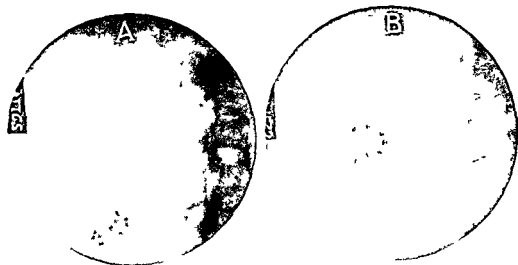


Fig 11 A Multiple shadows over right renobiliary region B cholecystography confirmed the biliary character of the shadows The borders of the faint gall bladder shadow have been outlined in white because although distinctly visible in the film they were too faint to be reproduced in an illustration

claim that only biliary calculi show a light center and dark peripheral zone In calculus 11, the loose structure of the greater portion of the calculus with resultant faint shadow is especially striking

Figure 18 shows 6 vesical calculi Only calculus 4 fails to yield a shadow, which bears out a not uncommon clinical experience One is often able to see a vesical calculus through the cystoscope, when radiography gives negative results

Figure 19 shows 16 large biliary calculi placed on a film, A The corresponding calculi are shown in B It will be noted that only 2 of the 16 calculi yield a uniformly dense shadow, i e, without any concentric layers In 4 there is some deposit of more opaque substance at the upper and lower poles In Nos 1, 12, and 16 there is distinct lamellation (especially in No 12) The remaining ten shadows are so faint that they would hardly show clinically with plain radiography, although the calculi are relatively large

Figure 20 shows plain film exposure and exterior of 24 moderate sized biliary calculi Nos 1, 2, 3, 4, 8, 13, and 23 all show a uniformly dense central and a lighter peripheral zone The remainder of the calculi yield a shadow which is so faint that it would scarcely show clinically with plain radiography

In Figure 21, a number of small biliary calculi were grouped to imitate conditions in the living It will be noted that, with only two exceptions, the shadows are so faint that one could scarcely expect to find shadows clinically on a plain film

In addition to the above observations, we would like to direct attention to a grouping of the shadows from four cases of biliary calculi (Fig 10) The shadow seen in A, is that of a biliary calculus with a dark center and

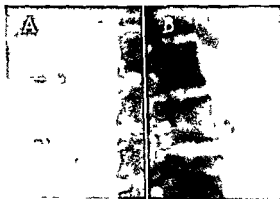


Fig 12 A plain film taken because of pain over left kidney region in a girl of 17 revealed two shadows with light center and dark periphery over the right kidney region as shown in 4 A lateral view after cholecystography shows that the shadows lie within that of the gall bladder (Courtesy of Dr J H Hess)



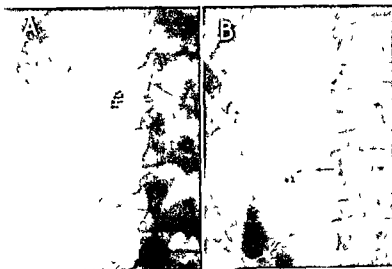


Fig. 13. Patient with symptoms and objective findings of right renal infection. A number of minute shadows (indicated by arrow) were visible in a plain film over the inner portion of the right kidney shadow. They appeared to be too far from the renal pelvis or one of its calyces to be of renal origin. In order to determine their true location a cholecystogram was made. This showed that the shadows were those of biliary calculi. Note how the gall bladder shadow lies directly over hilus of kidney in this second exposure. Compare with similar relation in case shown in Figure 5.

light periphery. The opposite is true of the shadow in B. The shadow of a common duct calculus seen in D is of uniform density. All

Opacity of urinary calculi according to atomic weight of their constituents. Opacity decreases from above downwards.

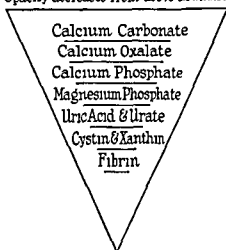


Fig. 14. Multiple shadows of calculi in a case of renal tuberculosis. Note lighter center and darker periphery.

Fig. 15. Order of density of urinary calculi. As explained in the text, this older view that the density of the shadow of any calculus is only due to the atomic weight of its constituents is not accepted. The structure and thickness of a given calculus play equally important parts in the degree of opacity.

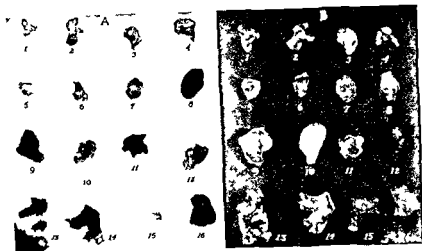


Fig. 16. Renal calculi removed at operation in 16 cases were placed upon a radiographic film in order to compare their opacity. Note the marked variation in density of the shadow as shown in 1 and compare these with the corresponding calculi as shown in B.



Fig. 17. A large number of renal and ureteral calculi were studied as in Figure 16 in order to learn the variation in the density of the shadows, A. The corresponding calculi are shown in B.

of these observations compel one to abandon the teaching that there is anything pathognomonic in the density of the shadow of a biliary calculus which enables one to distinguish it from that of a renal calculus.

*The form of the shadows.* One can at once exclude from consideration the so called branching or coral renal calculous shadows such as are shown in Figures 22 and 23. Such shadows do not present any difficulty because they

are, to a greater or lesser extent, casts of the renal pelvis proper and its calyces or one or more of the latter alone. In the two cases of concomitant renal and biliary calculi which we have seen such was the case (Figs. 22 and 23). In Figure 22, the multiple small biliary calculous shadows were at a lower level than the larger branching renal calculus.

One can, for practical purposes also exclude from consideration shadows which are of

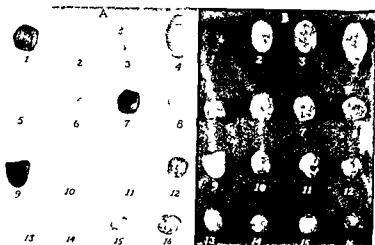


Fig 10 Sixteen large biliary calculi were placed on a radiographic film. Note the marked density of some of these calculi as compared to the almost translucency of others. The corresponding calculi are shown in the other half of the illustration.

relatively uniform size and show distinct facets, as in Figures 9 and 12. Such forms are seldom seen in renal calculi. The same is less true of the small, multiple, round, or slightly faceted shadows as seen in Figures 11 and 13. One must always bear in mind the possibility that such findings are occasionally encountered in renal calculi. Having thus excluded from consideration for practical purposes the shadows of the branching renal calculus absolutely and the faceted and very small biliary calculi, what remains? The reply is, the oval or round shadows, whether small or large, whether of unequal density or not. Owing to the enor-

mous increase in the number of radiographic exposures of the biliary and right kidney region this question of differentiation of such oval, round, oblong, etc. shadows constantly recurs at least in our services. The larger our experience, the less are we willing to make a diagnosis of a given shadow being of biliary origin from its location, opacity, and form. It is in such doubtful cases that cholecystography or pyelography, alone or combined, have proved to be the invaluable diagnostic aids to which we refer later.

*Change in position of the shadow or shadows.* We regret that our attitude toward this phase of the question is equally as skeptical as that toward the location, opacity, or form of a given shadow in the right upper quadrant being pathognomonic of biliary or renal calculus.

Urologists find that a renal or ureteral calculus can migrate far more than was ever believed possible before ureteropyelography was as universally employed as at present. It is not uncommon to find that a renal calculus is seen at one radiographic examination to be in the upper ureter or at the outlet of the renal pelvis (Fig 24 A). At another examination it may have changed its axis (Fig 24 B) and at a third be found in one of the calyces (Fig 24 C). A similar migration is



Fig 18 A Shadows cast by six vesical calculi. Note per m ability to \ ray of No 4. B Corresponding calculi

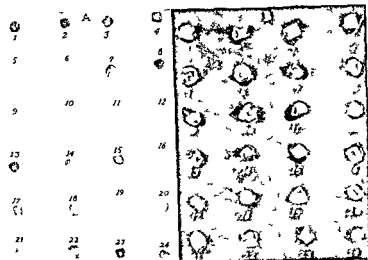


Fig. 20 Twenty four relatively small biliary calculi were placed on a radiographic film in order to compare the density of the shadows. Note how few of these biliary calculi would yield a shadow sufficient to show on a film in the living. The corresponding calculi are mounted in other half of illustration.

frequently seen when the ureter and renal pelvis are greatly dilated (Figs 25 and 26). Within the space of an hour, the shadow will be seen, alternately, in the kidney region and in the lower end of the ureter.

In regard to the mobility of biliary calculi one needs only to inspect such cases as are shown in Figures 12 and 13 to note that relatively small biliary calculi have a relatively wide range of mobility. In Figure 12 *A*, the two biliary calculi (in an anteroposterior exposure) are seen to lie close to the tip of the twelfth rib and on a line drawn through the lower border of the body of the first lumbar vertebra. In a lateral view these same calculi are seen opposite the middle of the next lower vertebral body. In Figure 13, the multiple small calculous shadows are seen (on a plain film) close to the transverse (right) process of the first lumbar vertebra. In a cholecystogram (Fig 13, *B*), the same shadows are visible opposite the right transverse process of the second lumbar vertebra.

That large biliary calculi, such as are shown in Figure 19, would change position to any extent, seems hardly plausible. The same is true of multiple faceted calculi of moderate size.

From all that has been said above regarding the mobility of biliary and renal calculi,

respectively, one is forced to the deduction that small biliary calculi can have a wide range of mobility. The same however, is true of small or even moderately large renal or ureteral calculi, provided that there is a concomitant dilatation of the upper urinary tract (Figs 25 and 26).

3. *Of how much value are cholecystography or pyelography or a combination of both?* It is beyond the scope of this paper to discuss either the technique or the value of cholecystography in general. We are chiefly interested

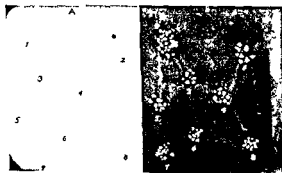


Fig. 21 A number of minute biliary calculi were placed in groups on radiographic films in order to determine the opacity of the corresponding shadows. Note the very faint shadows cast by the majority of these small calculi. In the other half of the illustration are shown the calculi rearranged.



Fig 22 Concomitant renal and biliary calculi. The calcareous shadow lies opposite right transverse process of third lumbar vertebra. The multiple shadows are opposite that of the fourth lumbar vertebra in a low lying gall bladder.



Fig 23 Shadow of a large branching renal calculus accompanying two shadows of biliary calculi which are outlined in white. There would be no difficulty in recognizing the intrarenal nature of the renal shadow because such a branching shadow is never seen in biliary calculi.

in the question as to whether a shadow in the right upper abdominal quadrant lies in the gall bladder, common bile duct, pancreas, or right kidney.

The value of cholecystography in enabling one to visualize non opaque biliary calculi is of especial interest, because somewhat similar methods must at times be resorted to by the urologist (Fig 27). In a series of 2,500

One of the four shadows seen in Figure 23 was due to a calculus in the common duct.

Two were shown a film by Dr. B. C. in 1917 in which a pancreatic calculus gave rise to a shadow in this area.



Fig 24 Two views of one of our cases in which the shadow of a calculus was first seen at a level corresponding to upper portion of ureter. A week later A it had migrated toward renal pelvis. At operation it was found in a lower calyx as shown in pyelogram B.

cholecystographies Case found that, for confirming or excluding the presence of biliary calculi cholecystography was reliable in 95 per cent of the cases in which calculi were found at operation.

Before resorting to either cholecystography or pyelography one should take films at various angles by rotating the patient e.g., anteroposterior right and left oblique and lateral positions. If such films do not settle the question as to whether the shadow is in the gall bladder or is extrabiliary we would suggest the following as a routine procedure.

**First, cholecystography alone.** If the gall bladder concentrates the dye one can usually see in an anteroposterior and lateral exposure whether the suspected shadow is intrabiliary or extrabiliary.<sup>3</sup> The cases shown in Figures 1, 2, 5, 11, 12, 13, 28, 29 and 30 are ample evidence of the value of cholecystography provided that the gall bladder concentrates the dye.

**Second, ureteropyelography alone.** If the ureter and renal pelvis are filled with an opaque solution (such as 12.5 per cent sodium iodide) the urologist is able not only to determine whether a given shadow is within the

With the exception of common duct calculi. (See Fig 10 D.)



Fig. 25 Shadow of calculus *A* and ureteropyelogram *B* from case in which calculus constantly migrated from renal pelvis to lower end of ureter and vice versa. (Courtesy of Dr. C. E. Kahlke)

renal pelvis or its calyces (Figs. 30 and 31) but also to state with some accuracy the exact location in relation to the pelvis proper or its calyces (Fig. 32). The only exception to the very accurate information obtained by pyelography is in rare cases such as the one shown in Figure 33. Here the shadow of the suspected calculus is separated from that of the pyelogram. We were unable to interpret this finding until, at operation, a calculus was found in a dilated lower minor calyx, the neck of which, or the communication with the pelvis proper and inferior major calyx, had been occluded as the result of stricture formation. Fortunately such a condition is rare, otherwise one would be unable to state that a given shadow is intrarenal because it is 'included' in a pyelogram.

Just as cholecystography enables one to visualize biliary calculi which are non-opaque so with ureteropyelography one can see filling defects or at least lessened opacity (Fig. 27) in some cases of ureteral or renal calculi which are non-opaque.

In several cases in which shadows were seen on the plain film, we were able to identify the shadows as being due to calcified retroperitoneal lymph nodes lying close to the gall bladder and right kidney region. These shadows



Fig. 26 *A* Ureteropyelogram of case in which ureteral calculus migrated from its location in pelvic portion of ureter indicated by arrow to the renal pelvis as shown in *B*



Fig. 27 How ureterography or pyelography enables one to visualize a non-opaque calculus. Plain radiography at two hospitals failed to reveal a shadow although a marked obstruction was encountered in the upper portion of the ureter with a ureteral catheter. Note filling defect in the ureterogram where calculus was found at operation. Insert shows shadow of calculus on film after operation. Patient was very obese.



Fig. 28 Large shadow of uniform density over right kidney suspected to be of biliary origin. Cholecystography revealed the extrabiliary character of the shadow. The edges of the gall bladder shadow have been outlined for the same reasons as given in Figure 11.

(Fig. 34) are always of unequal density, i.e. alternating lighter and darker areas. In addition, their outline is very irregular and serrated. In one case we were able by pyelography to exclude these shadows from consideration as being of biliary or renal origin.

*Third, cholecystography and pyelography combined.* A combination of these two methods is to be recommended in the following cases:

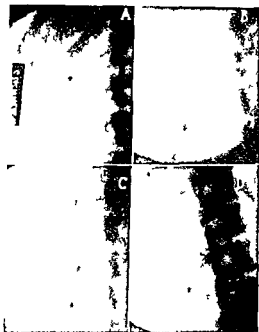


Fig. 29 A shadow was seen over that of the right kidney in a patient with symptoms of renal infection. In order to determine the location of the suspected calculus cholecystography was resorted to. The first exposure shows the shadow at the lower end of that of the gall bladder B but projecting slightly beyond it. A second film taken at a different angle shows the shadow more distinctly beyond that of the gall bladder. A lateral view confirms the extrabiliary nature of the shadow.

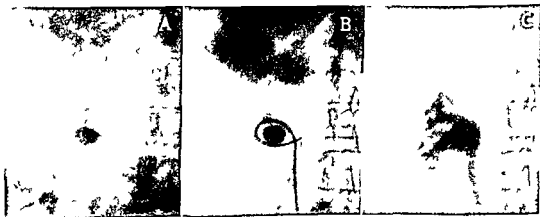


Fig. 30 As in the case shown in Figure 29 a shadow over the right kidney area was at first thought to be due to a biliary calculus. Cholecystography showed that this was not the case. In order to determine its location a urologic study was made. This revealed the fact that an

opaque ureteral catheter completely encircled the shadow B and that the shadow was included in a pyelogram C. Pyelotomy was done and a round calculus was removed from a pelvis in which migration had evidently taken place from the renal pelvis to a calyx and vice versa (Fig. 26).

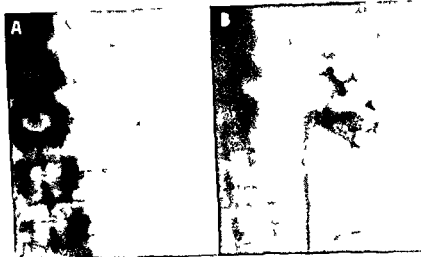


Fig 31 To illustrate how pyelography demonstrates the intrarenal character of a shadow over the kidney region. Note how the shadow seen in *A* is included in a pyelogram and may be seen as a lighter area *B* in a pyelogram.

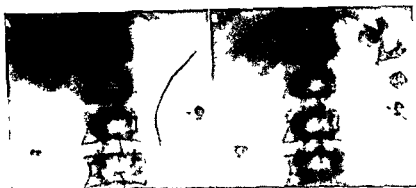


Fig 32 How pyelography enables one not only to determine the intrarenal character of a shadow but also its exact location in the kidney. The pyelographic medium (12.5 per cent sodium iodide solution) as seen in *B* cannot be injected beyond the shadow *A*, thus indicating a calculus impacted at the junction of the ureter with the renal pelvis on the right side. The pyelogram reveals the fact that on the left side the multiple shadows seen in *A* are located in the inferior major calyx.

a If cholecystography fails to yield a gall bladder shadow, pyelography will be invaluable.

b If there is any doubt concerning the intrarenal character of the shadow (Fig 30 *A*) in spite of its extrabiliary relation to a cholecystogram. Here the relation of the shadow to an opaque ureteral (Fig 30 *B*) catheter and its inclusion in a pyelogram will enable one to determine the location of the suspected calculus accurately.

c If the shadows are extrarenal and extrabiliary. In this group are included calcified

retroperitoneal lymph nodes (Fig 34) common duct calculi (Fig 10 *D*) pancreatic calculi and pigmented moles. We have encountered two cases during the past year which demonstrate the necessity of bearing in mind that the shadow of a pigmented mole can simulate that of a biliary or renal calculus. Both patients had been sent for radiographic examination because of pain in the right upper quadrant. In one case, the shadow was directly over that of the right kidney. On account of the faint opacity of the shadow the clinician was advised to look for a pig





Fig. 33

Fig. 33 This case illustrates an exception to the rule that one can not only determine the origin of a given shadow as being intrarenal but also localize it within the kidney. The shadow seen in A seems to be separated from the pyelogram. At operation the shadow was found to be due to a calculus lying in a dilated lower calyx, the neck

mented mole on the skin overlying the renal biliary region, where it was found in both cases.

4 *What other shadows must be considered?* The most common shadows which demand differentiation in our experience are those due to calcified retroperitoneal lymph nodes (Fig. 34). The variation in density of the shadow and the dentated edges are quite typical. Calcified areas in a tuberculous kidney, in a hypernephroma, and true calculi in a tuberculous kidney (Fig. 14) can all be distinguished by the use of cholecystography and pyelography, as well as by the irregular density of their shadows (Fig. 14).

#### COMMENT

1 The older criteria, as emphasized by Cole in 1917 which were employed to differentiate the shadows of biliary and renal calculi are of little value at the present time.

2 One can exclude from consideration the coral like or branching renal calculus.

3 The anatomical juxtaposition of the gall bladder and kidney in normal persons makes it possible to confuse shadows of biliary with those of renal calculi.

4 The radiographic opacity of any calculus is not only dependent upon the atomic weight of the constituents but to the structure and thickness of the calculus. 'Soft' calculi are much less opaque than 'hard' calculi



Fig. 34

of which had been occluded so that pyelographic medium could not enter the calyx.

Fig. 34 Typical shadows due to calcified retroperitoneal lymph nodes in right kidney region. Note variations of density and serrated outline of the shadows.

5 The form and opacity of biliary and renal calculi have many points of resemblance so that these two criteria alone cannot be considered pathognomonic.

6 The range of mobility of biliary calculi is as a rule greater than that of renal or ureteral calculi. If however the latter have formed in a dilated renal pelvis or ureter or both a wide range of migration is possible.

7 Cholecystography or pyelography or these two methods combined are very valuable additions to our diagnostic resources in the differentiation of biliary and renal calculi. Multiple exposures should be made by rotating the patient because in some positions the suspected calculus may appear to lie in the gall bladder or kidney, while in others its true position (Figs. 1 and 29) is at once evident.

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THE USE AND ABUSE OF IODIZED OIL IN THE DIAGNOSIS OF LESIONS OF THE SPINAL CORD<sup>1</sup>

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**I**ODIZED oil, in the form of lipiodol or iodipin, has played a definite part in the field of diagnosis ever since its introduction by LaFay, Sicard, and Forestier. Lipiodol radiologique descendant, N N R, is an iodine addition product of poppy seed oil containing 0.45 grams of iodine for each cubic centimeter. A similar preparation was used originally by LaFay in the treatment of epidemic encephalitis, later, Sicard and Forestier, finding that it was not unusually irritative to the meninges and that it was opaque to the roentgen ray injected it into the subarachnoid space and demonstrated compression of the spinal cord.

Its opacity and low degree of toxicity make it an ideal medium for use in the subarachnoid spaces of the spinal cord in demonstrating the presence or absence of compression of the spinal cord. The injection executed in the usual manner, either by means of lumbar or cisternal puncture, carries with it but little danger or risk. Observation of the descent of the oil under the fluoroscope and subsequent verification by roentgenograms determine the level of the compression or, if there is no arrest in the descent of the opaque medium, confirm a negative diagnosis.

But, comparable to so many other diagnostic measures, the use of lipiodol in this field has not only its limitations but also its elements of danger, consequently it should be considered as an aid in diagnosis rather than as a measure of primary importance. Mistaken diagnoses have often been made when only one diagnostic procedure has been recognized as the distinguishing factor. So, with diseases of the spinal cord if the roentgenologic data after the injection of lipiodol are emphasized to the disinclination of other methods of examination the inference is often misleading.

The test of any procedure is its application over an extended period in the hands of many experienced practitioners. Review of the literature emphasizes the fact that lipiodol is not

an innocuous ingredient, which is to be used in all cases of suspected compression of the spinal cord, but that it has its use and abuse. Its greatest use is in the confirmation of the presence of a suspected tumor of the cord, establishing the level of the tumor and demonstrating that discrete compression exists. Its greatest abuse is its injection in cases in which a thorough neurological examination would have elicited sufficient data from which to make a clinical diagnosis.

Sicard and LaPlane, in commenting on the use of lipiodol, emphasized the roentgen ray data in 2 cases after lipiodol had been used in making a differential diagnosis and stated that more than 300 suboccipital injections had been made under their observation without an accident. However, there occurs an irritative reaction of the meninges following the injection of lipiodol which varies in severity. The variance would appear to depend on the nature of the spinal lesion and the purity of the lipiodol, but the reaction seems to be universal and is the underlying factor in most of the discussions relative to the value of this medium in diagnosis. Balado and Franke said that the reaction is manifested by definite pleocytosis and that the cells called into phagocytic action are polynuclear and mononuclear leucocytes.

In discussing this reaction, Sicard and Forestier commented on a second reaction of the meninges to the introduction of iodized oil, they found that, on the second day after injection, the spinal fluid was clear and contained a normal amount of protein but that there were present from 100 to 200 polynuclear leucocytes in each cubic millimeter. This reaction subsided after the seventh day and unfortunate sequelæ did not result.

Ebaugh and Mella noted carefully the effect in 13 cases, they studied the spinal fluid and observed the systemic effects. They found definite evidence of aseptic meningitis, with increased cell count of the spinal fluid which subsided in 3 days. The systemic effects

<sup>1</sup> Read by title before the Society of Neurologists and Surgeons Rochester, Minnesota, June 11 and 12, 1938.

consisted of pain down both legs, elevation of temperature, nausea, and headache, these were not considered of sufficient consequence to contra indicate the use of lipiodol in the subarachnoid space

Lindblom carried out on rabbits a series of subdural injections of relatively large quantities of lipiodol and found that it gave rise to acute leptomeningitis as evidenced histologically by extensive infiltration of cells (mainly leucocytes) in from 2 to 3 weeks. Following this period, evidence of a residual inflammatory process could not be found in spite of large remaining quantities of lipiodol

Wolfsohn and Morrissey found a definite inflammatory reaction around 2 tumors, one, a neurofibroma and the other, a hæmangioma

Sharpe and Peterson, in reporting 3 cases in which lipiodol was used in making a differential diagnosis, described a case in which the reaction was so severe that laminectomy was necessary to dislodge the encysted globule of lipiodol

Hiller described a case of acute serous meningitis in a boy aged 8 years whose illness, before examination, had been of 3 months' duration. There was no segmental level of sensory disturbance nor a spinal fluid block. Lipiodol was used to determine the definite level of the pathological process. At operation evidence of marked inflammatory reaction, adhesions, and a cystic formation were found

Mackeddie reported 8 cases in which lipiodol had been used to confirm the diagnoses and to determine the level of the spinal lesion. He commented on the invaluable information elicited by its use but noted that he encountered temporary irritation to abnormal nerve tissue

Mixter and Ayer correlated their observations in experimental animals and in clinical cases and concluded that iodized oil is irritating to the meninges, that it remains as a foreign body and, therefore, that it should be used only when necessary. They further emphasized the absence of a subarachnoid block as a contra indication to its use

Armour noticed a distinct meningeal reaction in patients who were submitted for operation shortly after an injection of lipiodol. The meninges appeared thickened and somewhat red and the cerebrospinal fluid was slightly

turbid. He further stated that at the National Hospital, following injection of lipiodol an increase in root pain at the site of the lesion was commonly found and that this pain lasted for several hours. General soreness and stiffness and headaches occurred, and there was a slight rise in temperature, also, there had been increased difficulty in micturition in cases of lesions of the cauda equina. In a case which eventually proved to be one of disseminated sclerosis, the injection of lipiodol gave rise to twitching of the left arm and leg and to a sensation of "pins and needles" in the left side of the face which lasted for 24 hours. Forestier maintained that severe sequelæ are not due to the lipiodol but to the puncture alone, he did not believe that lipiodol should be regarded as a permanent foreign body, because, even if it takes a long time to be absorbed, the absorption is at any rate, continuous by means of normal histological reaction. Armour summarized the use of lipiodol by saying that its employment should in no way usurp the place of several and repeated clinical examinations of the patient. He believes that the determination of a segmental level of sensory disturbance combined with a laboratory test of the cerebrospinal fluid is especially important. Recourse to the use of iodized oil as a labor saving device and a short cut to diagnosis and localization cannot be too strongly deprecated. It should be used only after a subarachnoid block, first demonstrated by the combined cistern puncture which was introduced by Ayer, also it should not be employed unless the possible danger of complications is outweighed by the more exact localization likely to be obtained. Finally, in properly selected cases, lipiodol is a definite aid in the study of compression of the spinal cord which, if used intelligently, will definitely increase the possibility of successful removal of tumors of the spinal cord. Furthermore, the tumors can be detected and removed at an earlier stage in the course of the disease, thereby the percentage of cures is increased and the operative mortality is reduced

#### REPORT OF CASES

Diagnosis and localization of tumors of the spinal cord have been materially improved since

the introduction of iodized oil, and a review of a series of cases at The Mayo Clinic has emphasized many pertinent facts. Lipiodol radiologique descendant N N R was injected in every case into the cisterna cerebellomedullaris (cisterna magna) with the patient in a prone position. When the patient was removed to the fluoroscopic room, the head of the fluoroscopic table was gradually elevated and the iodized oil was observed to descend in the subarachnoid space, following the fluoroscopic examination roentgenograms were made, after an interval of 12 and 24 hours, a second and a third series of plates were made. The combination of these roentgen ray examinations constituted the diagnostic results of the injection of lipiodol. Ten cases were selected to exemplify one or more points of interest, and, for convenience in summarizing the advantages and disadvantages of the use of lipiodol in these cases, the points were listed as uses and abuses. The first 5 cases illustrate the uses of iodized oil, and the case histories evaluate not only the justification of its employment but also the invaluable information elucidated by subsequent roentgen ray examination.

The first case presents a picture of numbness and weakness of the lower extremities with an insidious onset and without a history of pain. A definite segmental level of sensory disturbance was elicited on careful neurologic examination but when spinal puncture was made block could not be demonstrated in the subarachnoid space. Contrary to the observation of many contemporaries, that lipiodol should not be used in the absence of subarachnoid block, and in accord with the observation of a few others injection of the cisterna cerebellomedullaris was carried out definite compression and block corresponding to the level of sensory disturbance, was established by means of lipiodol.

**CASE 1** The patient reported at The Mayo Clinic October 17, 1927, complaining of numbness of both legs. The history was of one and one half years duration the legs had become numb simultaneously and the numbness had extended slowly and gradually to the epigastrium. Slight weakness developed about 6 months after the onset of the numbness and at the same time a heavy piece of iron fell on the patient's left foot without causing subsequent pain. Associated with the numbness and weakness unsteadiness of

gait and slight pain down both legs developed. A few months before admission both vesical and anal sphincters had become involved which necessitated enemas and the use of a catheter. General examination including a roentgenologic examination of the spine was negative. Neurologic examination revealed a level of sensory disturbance corresponding with the seventh dorsal segment with bilateral decrease in strength and tonus of all muscles below this level. Patellar and tendon of Achilles reflexes were moderately increased bilaterally (graded 2+) and there was bilateral ankle clonus, both cremasteric reflexes were abolished and there was lack of coordination bilaterally in the heel to toe test the gait was markedly ataxic and both lower extremities were spastic. Examination of the spinal fluid revealed negative Kolmer and positive Nonne reactions there were three small lymphocytes in each cubic millimeter. The fluid was clear and colorless. On bilateral compression of the jugular veins there was prompt elevation of the level of the fluid in the manometer this is Queckenstedt's sign and henceforward in this paper this portion of the examination will be referred to simply as the 'response to jugular pressure'. In view of the absence of spinal block negative roentgenological examination and the presence of cells in the spinal fluid a diagnosis was made of a lesion of the spinal cord probably inflammatory and injection of lipiodol was advised. Two cubic centimeters of lipiodol radiologique descendant N N R were injected into the posterior cistern and under the fluoroscope were seen to descend to about the fourth dorsal vertebra where the lipiodol split into two columns and stopped at the level of the sixth dorsal vertebra. Twelve hour and 24 hour roentgenograms verified this observation (Fig. 1). Exploratory laminectomy was advised and performed consisting in the removal of the spines and laminae from the fourth fifth and sixth dorsal vertebrae a definite tumor was found situated opposite the fifth and sixth dorsal vertebra on the dorsal aspect of the cord and the dura producing a saddle like mass around the cord. It came from the vessels opposite the sixth dorsal vertebra on the right side. The tumor was completely removed without breaking its capsule and proved microscopically to be an hæmangioma. The patient made an uneventful convalescence and regained control of the sphincters at dismissal he was able to walk about without difficulty and sensation was beginning to return to the lower extremities.

In accordance with the dictum, sometimes given, that a diagnosis of tumor of the spinal cord cannot be made definitely unless there is no response to jugular pressure and in spite of the observation that lipiodol should never be used in the absence of subarachnoid block in another case in the series iodized oil was utilized to localize a tumor. Forestier, in emphasizing the use of iodized oil in lesions of the

spinal cord, has stated repeatedly that tumors should be localized earlier by utilizing this diagnostic measure in comprehensive examination. The following case and the previous one illustrate the truth of Forestier's contention. It is possible that with a definite level of sensory disturbance exploration would be justified, but in the absence of other confirming signs it is most reassuring to have roentgenograms verifying the site of the lesion.

**CASE 2.** The patient, a woman, came to The Mayo Clinic June 2, 1927, complaining of weakness and numbness in the legs which had been gradually progressive during the 2 previous years. The difficulty began with numbness and a drawing sensation in the right heel following which weakness developed in the right foot. The weakness then spread to the left foot and gradually involved both legs. For 5 months before registration the patient had been unable to walk except with a cane or with help. With the increasing weakness pain developed in both extremities. The pain came on at night usually about 2 a.m. and was relieved by getting up, walking about and assuming a sitting posture. General examination including a roentgenologic examination of the spine was essentially negative. Neurologic examination showed loss of strength of the muscles of both lower extremities, patellar reflexes were increased bilaterally and there was loss of abdominal reflexes, bilateral Babinski, Oppenheim and Chaddock reflexes were present, a disturbance of sensation the upper level of which corresponded with the distribution of the eighth and ninth dorsal segments was noted. Examination of the spinal fluid showed negative Kolmer and positive Nonne reactions and normal color. There was prompt response to jugular pressure. In view of the history and the neurologic data a diagnosis was made of lesion of the spinal cord opposite the eighth dorsal vertebra but because of the response to jugular pressure injection of iodized oil was carried out. Two cubic centimeters of lipiodol were injected into the cisterna cerebellomedullaris and under the fluoroscope it was seen to flow readily to the level of the seventh dorsal vertebra where it formed a U-shaped block. Roentgenograms taken later verified this (Fig. 2). Accordingly a diagnosis was made of tumor of the spinal cord and laminectomy was advised at operation a rounded tumor arising from the arachnoid and the dura was found opposite the eighth dorsal vertebra (Fig. 3). The tumor was an intradural fibroblastoma producing indentations of the cord and reducing the cord to about four fifths of its normal size. The tumor was removed and the patient made an uneventful recovery.

The ultimate aim of every diagnostician is so to interpret the pre-operative data that a differential diagnosis of the underlying patho-

logical process can be made. In the use of lipiodol the interpretation of the roentgenogram is of paramount importance and to the shape of the shadow cast has been attributed the indication of the nature of the lesion or the process involved. Myer stated that a cap or crescent, complete or incomplete should be interpreted as an extramedullary tumor or Pott's disease with an intraspinal abscess and that narrow lines of lipiodol at either side with an irregular mass above suggest fusiform enlargement of the cord. Eskuchen in Germany and Piccinini in Italy hold that it has not proved possible, as was at first hoped to draw any conclusions from the form of the shadow cast by the lipiodol as to the relation of the lesion to the meninges and cord or as to the pathological nature of the lesion. Supporting the last statement that a pre-operative pathological diagnosis cannot be made from the roentgenologic data after injection of lipiodol, the following case is presented. The history was not typical of tumor of the spinal cord but suggested an inflammatory lesion. The normal spinal fluid however, eliminated this possibility so that even in the presence of a definite level of sensory disturbance and in the absence of a response to jugular pressure, lipiodol was used to attempt a differentiation of the underlying pathological process.

**CASE 3.** A man aged 25 years registered at The Mayo Clinic October 16, 1927, complaining of paralysis of both legs. He had apparently been well until 1913, 4 years previously when pain in the upper part of the spine radiating into the inguinal region came on suddenly within 2 weeks after the onset of pain his legs became weak and after a month he was unable to walk. He recovered from this within another month but in August 1920, 3 years after the initial onset the backache returned the pain was worse with activity and was relieved by rest. Weakness of the lower extremities developed and for 5 weeks previous to admission he was unable to walk because of it. Between the attacks the gait had been normal although the patient thought that subsequent to the original attack he had never recovered the full strength of his legs. Roentgenologic examination of the spine was negative. There was marked spasticity of both lower extremities with a level of sensory disturbance corresponding with the tenth and eleventh dorsal segments. There was increase of patellar reflexes on both sides with loss of the tendon of Achilles reflex on the right. Bilateral ankle clonus was present and abdominal reflexes were abolished. Bilateral positive Babinski could be elicited. Exami-

nation of the spinal fluid revealed negative Kolmer and positive Nonne tests and normal color. There was no response to jugular pressure. In view of the confusing history and in spite of the lack of response to jugular pressure and the definite level of sensory disturbance, injection of lipiodol was considered advisable for differential diagnosis. Two cubic centimeters of lipiodol radiologically descendant N N R were injected into the cisterna cerebellomedullaris and its descent was observed under the fluoroscope. When the lipiodol had descended to the level of the eighth dorsal vertebra there was a definite block and a definite dome shaped shadow. A roentgenogram made 12 hours later showed the dome shaped obstruction opposite the eighth dorsal vertebra (Fig. 4). Laminectomy was performed and enlargement of the cord was found opposite the eighth dorsal vertebra. At first this was thought to be an intramedullary cord tumor when it was viewed from the anterior aspect; it was seen to be cystic and on being opened it was found to contain yellow fluid. It was emptied and curetted and the wound was closed. The patient made an uneventful convalescence but his condition was not materially improved after operation.

The neurologist is often confronted with the task of making a differential diagnosis of an inflammatory lesion or of a tumor of the spinal cord and there is often a great deal of difficulty in making such a differentiation. Very few cases of lesion of the spinal cord afford clear cut histories and typical results of neurologic examination. In the following case there was a rather difficult history and indefinite results of neurologic examination associated with a positive Queckenstedt test. Although the cell count was 28 lymphocytes in each cubic millimeter and the Nonne test was positive there was no other evidence that the disease was of an inflammatory nature, consequently lipiodol was used in an effort to determine the underlying pathological process. Since the lipiodol descended in the subarachnoid space and opposite the eighth thoracic vertebra separated and descended in two streams the presence of a tumor of the spinal cord could not be ruled out. In fact in view of the lack of response to jugular pressure the presence of an intramedullary tumor was suggested and lipiodol was used to indicate the definite level of the disorder.

CASE 4. A married woman aged 29 came to The Mayo Clinic March 22, 1927 complaining of pain in the back which had been present for 20 months. In August 1925 when the patient was 2 months preg-

nant, she began to have a dull pain in the sacro iliac region at night relief was obtained by getting up and as a result she would sleep propped up in a chair. In September 1925 she began to have flashes of pain down both legs for a half hour at a time relief for 2 or 3 hours would follow the periods of pain. The pain continued until June 1926, when that in the leg disappeared although the pain in the back persisted the patient also noticed numbness of both lower extremities which began with the onset of pain and which progressed insidiously until the time of admission. Roentgenologic examination of the spine was negative. There was loss of strength of the muscles of the right lower extremity. Both tendon of Achilles reflexes were abolished, there was rather marked inco-ordination of both extremities. A level of sensory disturbance could not be determined. Examination of the spinal fluid showed negative Kolmer and positive Nonne reactions the color was yellow and there were 28 lymphocytes in each cubic millimeter. There was no response to jugular pressure. In view of the history and indefinite level of sensory disturbance as well as the lack of response to jugular pressure lipiodol was advised for the purpose of differentiating the type of lesion as well as for establishing the level of the lesion. Two cubic centimeters of lipiodol was injected into the cisterna cerebellomedullaris and was seen to descend until opposite the level of the fifth thoracic vertebra the lipiodol separated and descended in 2 streams to the level of about the eighth thoracic vertebra. Roentgenograms confirmed this (Fig. 5). Laminectomy was performed and diffuse leptomeningocystic myelitis of the dorsal portion of the cord was found extending as high as the fourth dorsal vertebra and as low as the eighth dorsal vertebra. The arachnoid pia mater, and cord were adherent presenting a grayish appearance with tortuous veins running through the mass. On splitting the cord dorsally a simple cyst containing brownish yellow fluid was found and the fluid was aspirated. The cystic cavity extended from about the fourth dorsal vertebra to about the end of the cord so far as could be made out. The patient's convalescence was uneventful and she showed slight improvement at the time of dismissal.

The fifth case in the series is an excellent example of the use of lipiodol in cases of questionable lesion of the spinal cord. Its use here consisted in the elimination of definite compression of the cord in the face of an indefinite level of sensory disturbance and slow return to normal following the application of jugular pressure during spinal puncture. The lipiodol descended in the subarachnoid space without interruption, and operation was resorted to only in an effort to demonstrate a definite lesion which might be relieved by laminectomy. The case only intensifies my impression

that lipiodol has its uses in eliminating a possible lesion when other data are confusing

**CASE 5** The patient reported at The Mayo Clinic March 9 1928 complaining of increasing difficulty in walking a sensation of constriction around the trunk and ankles and numbness and tingling of the lower extremities. He had been in good health until January, 1927, when he began to notice numbness and tingling in both feet and legs and at about the same time the gait became unsteady and the legs and feet became more susceptible to cold. These symptoms had progressed slowly until 7 months later when he had noticed a constricting sensation as though a band had been laced about the lower part of the abdomen. At the same time, he noticed difficulty in urination and in defecation. In January, 1928, a sharp shooting pain developed about the precordium. Urinalysis showed specific gravity 1.024 acid reaction and a slight amount of pus. The blood count was normal and the Wassermann reaction of the blood was negative. Roentgen ray examination of the spine did not show any demonstrable lesion. Neurological examination elicited a definite decrease in tonus and speed of reaction of the muscles of both lower extremities with increase of both patellar and tendon of Achilles reflexes. There was loss of both epigastric reflexes positive Babinski and Chaddock reflexes were present bilaterally and there was definite inco-ordination with spastic gait and a positive Romberg sign. Examination of the spinal fluid demonstrated a negative Wassermann reaction, a positive Nonne reaction normal color, and negative microscopic appearance. There was prompt response to jugular pressure but very slow return to normal. An indefinite level of sensory disturbance could be fairly well determined the upper limits of which were at the level of the eighth dorsal segment. In view of the history of slow progression the indefinite evidence concerning the level of the disturbance, and the slow return to normal after jugular pressure a diagnosis was made of lesion of the spinal cord and injection of lipiodol was instituted as a confirmatory measure. Lipiodol in the amount of 2 cubic centimeters was injected into the cisterna cerebellomedullaris and under the fluoroscope was observed descending in the subarachnoid space, it went down without interruption passed the site of the suspected lesion and collected below in the dural culdesac. In spite of the negative roentgenological data exploratory laminectomy was performed and a diffuse inflammatory lesion was found. A tumor could not be demonstrated.

The use of lipiodol, as emphasized in the foregoing cases, has been an aid to complete general and neurologic examinations in making a differentiation between confusing lesions of the spinal cord as well as serving as an indicator for surgical procedures. In contrast there are certain cases in which the injection of

lipiodol is not only unnecessary but is also contra indicated and the following cases illustrate the superfluous application, as well as the deleterious effect, of this medium. As already mentioned authorities have emphasized the fact that lipiodol acts as a foreign body stimulating an inflammatory reaction of the meninges. The first case in the series, demonstrating the abuse of lipiodol, exemplifies that limitation to its use. This case came under observation shortly after lipiodol had been injected elsewhere, collaboration was made with the original examiner and the results of spinal fluid investigation were compared. A definite inflammatory reaction of the meninges was demonstrated which gradually disappeared during the time of observation at the clinic. The history was one of an inflammatory condition, there was not, at any time, a lack of response to jugular pressure and there was a definite exacerbation of symptoms following injection of lipiodol.

**CASE 6** A man aged 56 years reported at The Mayo Clinic complaining of paralysis of the lower extremities and numbness of the feet and toes. He had been in excellent health until a year previous to registration when he had caught a severe cold and subsequently influenza had developed. He had apparently recovered from the influenza but a month later a severe generalized headache had developed which often waked him from profound sleep 2 months after the attack of influenza he awakened one morning with paralysis of the distribution of the seventh cranial nerve on the right side following which the headaches ceased. Examination at this time including examination of the eyes was negative. The paralysis of the right seventh cranial nerve gradually disappeared after a week and the patient's general condition remained good until about 8 months after the influenza when he suffered from severe abdominal pain began to have difficulty in voiding and complained of cold feet and numbness of the toes. Immediately following this marked weakness of the left leg developed the anesthesia of both lower extremities had ascended and had involved the perianal region. The condition remained stationary for 2 months when he suddenly noticed severe pain in the right lower extremity followed by loss of motor function. At this time examination revealed a negative Wassermann reaction absence of knee and ankle jerks and a bilateral Babinski reflex there had been loss of tactile sensibility over the anterior portion of both legs absence of cremasteric reflexes and decrease of tonicity in both the vesical and anal sphincters. Spinal puncture had been made at this time the Wassermann and Nonne reactions

had been negative the fluid was yellow and microscopically it had shown the presence of a few erythrocytes. Lipiodol in the amount of two cubic centimeters had been injected into the cisterna cerebellomedullaris and was seen to descend to the upper level of the fourth lumbar vertebra where it was temporarily arrested but it had passed on down leaving fragments in its wake (Fig. 6). Following injection of lipiodol the pain had become more intense, weakness of both lower extremities had become more marked and there had been a definite decrease in tactile sensibility over both lower extremities. At this time, the patient was referred to the clinic with a diagnosis of lesion of the spinal cord. After registration and 9 days following the injection of lipiodol another examination of spinal fluid was carried out revealing negative Kolmer and positive Nonne reactions, 11 large lymphocytes, 276 small lymphocytes and 1 polymorphonuclear leucocyte in each cubic millimeter the color was slightly yellow. There was prompt response to jugular pressure. The pain gradually lessened in severity and the patient's physical condition began to improve but the improvement was so slow that a third spinal puncture was made 19 days later. The cerebrospinal fluid although colorless was slightly turbid there were negative Kolmer and positive Nonne reactions, 4 large lymphocytes, 139 small lymphocytes, and no polymorphonuclear leucocytes in each cubic millimeter there was prompt response to jugular pressure. The patient gradually became better and was permitted to return home. Four months after dismissal he was able to walk without assistance although there was still urinary retention.

Ebaugh, in his experimental studies demonstrated that the systemic effects of the introduction of iodized oil into the subarachnoid space, such as pain in the legs were transitory. Forester has maintained that any severe sequelae are not due to lipiodol but to the puncture alone, justifying his assertion by stating that lipiodol should not be regarded as a permanent foreign body because its absorption is continuous by means of a normal histological reaction. Conversely to these assumptions the following case illustrates accentuation of pain ever and lasting after the introduction of lipiodol. The history which was essentially one of bilateral sciatic pain, did not point definitely to a lesion of the spinal cord and, in fact a complete examination was practically negative. Lipiodol was used in an effort to demonstrate or rule out the possibility of a very early tumor of the spinal cord. It descended almost immediately in the subarachnoid space to the lumbar culdesac, the patient complained of

increase of pain following the injection and this persisted for several months after his return home, incapacitating him for work. The case demonstrates clearly that lipiodol cannot be used indiscriminately in every case of bilateral pain, or of bilateral sciatica, when other features of the examination do not point to a definite lesion. In the light of the results, conclusions regarding this case were that lipiodol should not be injected in the face of such meager evidence of compression of the spinal cord.

**CASE 7.** A man aged 46 years registered at The Mayo Clinic April 27, 1927 complaining of pain in the back which extended to the left leg, and which had been present for 10 months. Ten years previously he had had a 3 weeks attack of steady rather severe pain which involved the left sacro iliac region the posterolateral part of the left thigh, and the left calf. The pain had cleared up completely in 3 weeks and the patient did not have trouble again until June 1926, when while loading a wagon, he fell about 6 feet landing on his feet. The result was severe pain in the left sacro iliac region, which gradually grew more severe descended into the left leg and then involved the right leg the pain was worse at night and was relieved by getting up and moving about. General and neurologic examinations were carried out. Roentgen ray examination of the spine was negative. It was noticed that flexion of the head on the chest caused increase of pain. There was mild atrophy and fibrillary twitching of the tendons of the left biceps flexor femoris (external hamstring) and peroneal muscle there was definite loss of the tendon of Achilles reflex on the right and there was no definite level of sensory disturbance. Examination of the spinal fluid revealed negative Kolmer and positive Nonne reactions and negative microscopic appearance. There was prompt response to jugular pressure. The pain was not relieved by any of the usual methods of treating sciatica and the question of the possibility of a tumor of the spinal cord was considered consequently injection of lipiodol was instituted. Two cubic centimeters of lipiodol radiologically descendant, N N R was introduced into the cisterna cerebellomedullaris without difficulty under the fluoroscope it was observed that the lipiodol descended rapidly within the subarachnoid space and, in a very few moments the major portion had reached the lower end of the dura, extending from the lower region of the fourth lumbar vertebra to the second sacral vertebra. Roentgenograms, made 12 and 24 hours later confirmed this (Fig. 7). Therefore, with a history of bilateral sciatica, worse at night, normal spinal fluid prompt response to jugular pressure and negative results from the injection of lipiodol the presence of tumor of the spinal cord was eliminated. However the patient complained of an increase in pain after return home, with additional pain low in the back and in the lumbar and sacral regions. The



pain resisted all efforts toward alleviation and seemed to increase in severity

Robineau after observing 100 cases after injections of lipiodol, was of the opinion that the procedure is harmless but he modified this statement by saying that it should be subordinate to the clinical examination. One abuse of the procedure of injection of lipiodol is its use in cases in which the clinical investigative procedure suggests a definite inflammatory lesion of the spinal cord. In the following case the history and examination of the spinal fluid strongly suggested meningomyelitis, but in an endeavor to distinguish a neoplastic from an inflammatory process, injection of lipiodol was carried out. At operation the lesion was unequivocally inflammatory and appeared to be an acute lesion superimposed on a chronic process.

**CASE 8.** The patient came to The Mayo Clinic July 11, 1921, complaining of pain which had been present for 3 years in the lower part of the lumbar spine and right leg. Following an operation for chronic appendicitis 4 years previously, the patient had begun to have severe pains in the back which radiated down the thighs and legs. There had been relief for about a year and then the same pain had reappeared. After a trip West in an automobile she had almost entirely recovered but about February 1927 the trouble had returned and had persisted. An epidural injection of 1 per cent procaine was given and the patient obtained relief for about 12 hours; however the pain returned and the patient lost considerable weight. The roentgen ray appearance of the spine was normal. There was absence of localized weakness of the lower extremities. The tendon Achilles and abdominal reflexes were normal bilaterally, a definite level of sensory disturbance could not be ascertained. A spinal puncture was made and there was no response to jugular pressure. The fluid gave a negative Kolmer reaction and was of dark yellow color, coagulated on standing, and the total protein content was 2920. A diagnosis was made of unlocalized lesion of the spinal cord probably inflammatory, and in view of the doubtful history and positive Queckenstedt test as well as the coagulation of the fluid, injection of lipiodol was advised. Lipiodol in the amount of 2 cubic centimeters was injected into the cisterna cerebellomedullaris and was observed under the fluoroscope to descend and then to stop at the lower border of the eighth dorsal vertebra. The shadow cast by the iodized oil as seen by the roentgenogram was not characteristic of a tumor of the spinal cord but was funnel shaped giving the impression of an inflammatory lesion (Fig. 8). Exploratory laminectomy was performed at which time the spines and laminae

from the seventh and eighth dorsal vertebrae were removed thus exposing a diffuse area of meningomyelitis. A definite inflammatory reaction was observed after incision of the dura with multiple cysts containing thick yellow fluid. The entire inflammatory process appeared to be acute and superimposed on a chronic lesion probably induced by the lipiodol. The patient's convalescence was without incident but she did not show any definite improvement following the operation.

This case shows that in chronic inflammatory lesions of the spinal cord lipiodol by its irritative action, may set up an acute inflammatory reaction superimposed on the lesion.

One more case in the series was selected as an example of abuse of iodized oil, because it not only demonstrated that an inflammatory reaction is produced around a tumor by lipiodol but, in view of the unfortunate termination of the case, it raises the question of the possibility of a systemic reaction. In retrospect, it seems possible also that lipiodol was used in this case as a short cut and was not subordinated to the clinical investigation.

**CASE 9.** The patient came to The Mayo Clinic November 17, 1927, complaining of occasional attacks of pain which had persisted for 3 years and which had been limited to the small of the back. In January 1927 a dull pain had occurred which had been localized in the right lower quadrant, one month later appendectomy had been performed following which the pain in the back had become much more severe and constant, was worse at night and radiated along the course of the right sciatic nerve to about the knee. In May 1927 the patient had noticed definite progressive atrophy of both legs. In October 1927 after he had had all possible foci removed he entered the hospital for further treatment. Extension was applied and the patient grew worse, numbness and tingling in the right leg extended up to the knee. Cerebral and neurological examinations revealed loss of tactile pain and temperature sense in both lower extremities with preservation of immediate perianal sensation. There was marked atrophy of both lower extremities as well as loss of all reflexes below the hips. Examination of the spinal fluid revealed a negative Kolmer reaction, yellow fluid which coagulated rapidly and no response to jugular pressure. Injection of lipiodol had been made about a week previous to registration and roentgen ray examination of the spine revealed lipiodol which had descended in the subarachnoid space to the level of the third lumbar vertebra (Fig. 9). Laminectomy was advised and carried out at which time a tumor of the cord about 2.5 centimeters in length and fusiform in shape was exposed and removed. Surrounding the tumor were many adhesions to the fibers of the cauda equina and there was a definite acute inflammatory



Fig 1 Injection of lipiodol Tumor of the spinal cord localized by means of iodized oil in the presence of clear fluid and negative Queckenstedt test



Fig 2 Arrest of lipiodol above tumor of the spinal cord with some iodized oil in the cul de sac in this case the cerebrospinal fluid was clear and there was a negative Queckenstedt test

reaction. The tumor was removed completely, with very little if any trauma to the spinal roots. It proved to be an ependymal cell glioma which had degenerated within its center and had become cystic. The marked inflammatory reaction around the tumor which involved all of the fibers of the cauda equina was probably set up by the injection of lipiodol. Following the operation the patient was returned to his room and although in a weakened condition from the procedure was not considered in danger. However 3 hours afterward he died suddenly. Necropsy did not reveal a cause for death. The question arises whether the lipiodol could have had anything to do with sudden death in this case.

In the final case as in the preceding one the history, the neurological examination and the spinal puncture together with examination of the spinal fluid, suggest that probably lipiodol was injected unnecessarily. This case has been selected to demonstrate further that even in view of the successful removal of the tumor with recovery of the patient, one of the abuses of lipiodol is its injection in the face of a positive history and examination.

**CASE 10.** A man aged 66 years registered at The Mayo Clinic because of paralysis of both legs and

pain in the back. Three years previously he had begun to have severe pain in the sacral area. Years later the pain became almost constant, was worse at night and was relieved by sitting up, the pain increased in severity and about 6 weeks prior to registration paralysis of both legs more marked in the left suddenly developed. General and neurologic examinations revealed loss of strength and of speed of reaction and tonus of all of the muscles of both

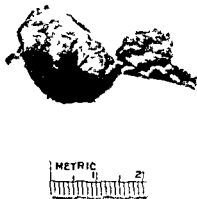


Fig 3 Intradural extramedullary meningioma



Fig. 4 Dome shaped shadow cast by an intramedullary cyst of the spinal cord



Fig. 5 Descent of lipiodol in two lateral lines in a case of inflammatory lesion



Fig. 6 Injection of lipiodol in a case of extensive inflammatory lesion of the spinal cord in which there was an acute exacerbation and ultimate recovery



Fig. 7 Injection of lipiodol in a patient suffering with bilateral sciatica with exacerbation of pain

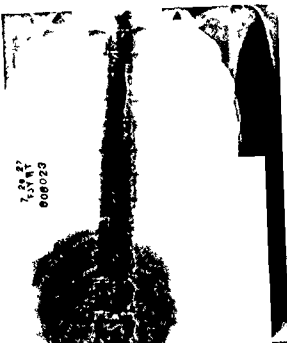


Fig 8 Injection of lipiodol in a case of diffuse meningo-myelitis

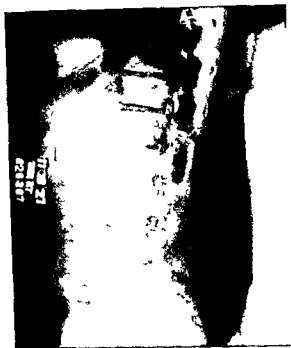


Fig 9 Injection of lipiodol showing definite localizing signs and inflammatory reaction about the tumor and cauda equina

lower extremities. Patellar and tendon of Achilles reflexes were abolished. There was definite saddle anaesthesia and loss of tone in the anal and rectal sphincters. Examination of the spinal fluid showed negative Kolmer and positive Nonne reactions, the fluid was yellow tinged and there was no response to jugular pressure.

A diagnosis had been made elsewhere of tumor of the spinal cord and a week previous to admission, lipiodol had been injected and roentgen ray examination of the spine at the time of examination at the clinic showed the lipiodol opposite the body of the eleventh dorsal vertebra (Fig 10). Laminectomy was advised and performed on exposure of the dura opposite the twelfth dorsal vertebra it was found to be very tense and the impression gained was that the dural sac was markedly distended with some sort of a mass, on opening the dura it was obvious that a tumor existed anterior to the conus. On further exploration a tumor was found which filled the entire lumbar canal besides extending up into the dorsal canal. On exposure of the upper border of the tumor cloudy cerebrospinal fluid escaped and the entire tumor was surrounded by a flocculent exudate which was causing marked adhesions between the tumor, fibers of the cauda equina, and meninges. The tumor was completely removed and the patient recovered but the function of the lower extremities and sphincters did not return to normal.



Fig 10 Injection of lipiodol demonstrating caudal tumor in which there had been a superimposed inflammatory reaction about the lesion

## CONCLUSIONS

Iodized oil injected into the subarachnoid space is an invaluable adjunct in the armamentarium of the neurologist and the neurologic surgeon in diagnosing compression of the spinal cord but it has its use and abuse. This diagnostic procedure should always be employed in conjunction with a complete examination and the results obtained should never occupy more than relative importance in the establishment of a diagnosis, the irritative action on the meninges contra indicates its use in frank inflammatory lesions. By the use of iodized oil the presence of tumor of the spinal cord can be detected earlier in certain cases and the fact that there is a response to jugular pressure does not preclude its use. The outstanding use of lipiodol is for the confirmation of a suspected tumor of the spinal cord and its greatest abuse is its employment in cases in which a complete examination would have established a diagnosis.

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# VARICOSE VEINS—THE CIRCULATION AND DIRECTION OF THE VENOUS FLOW

## EXPERIMENTAL PROOF

DE

H O MCPHEETERS M D I ACS AND CARLO RICCI M D MINNEAPOLIS MINNESOTA

THE subject of disability caused by varicose veins has been given much consideration during the past few years. This is especially true since the advent of the injection treatment by means of sclerosing solutions.

The method of the injection directly into the blood stream of a destructive solution with the idea of producing thrombus formation, which is always regarded as the parent of an embolus, seems unscientific and certainly non-surgical. It is in the attempt however to prove that the direction of the venous flow in varicose veins tends to prevent embolus formation rather than produce it that we have undertaken this bit of experimental work.

Normally all venous flow is upward, both in the superficial and the deep system of veins. The deep veins scattered through the muscles of the lower leg are supported by the surrounding muscles and strong fascial layers. This prevents the walls from giving way and producing varicosities. The action of these muscle layers tends to collapse these veins, thus forcing the contained blood upward with a pump like action. The veins of the superficial group, however, have no support other than their own walls and that of the surrounding fascia which is mostly soft adipose tissue. The fat offers but little support to the vein walls and at times practically disappears. The skin while possessing the turgor of youth does not prevent the veins from dilating in the fatty layers and becoming elongated and tortuous. In later life even this tonicity of the skin is lost and the veins often become but little more than large saccules of stagnant blood. Whether the primary factor in the etiology here is the loss of the valve function (2) or an injury to the vein wall from infection (2) permitting the vessel to dilate and throw extra stress on the valves in the saphenous vein, is a much debated question.

It is our contention that in all varicose veins and particularly in those in which valve action has become deficient either through a primary destructive injury to the valve or secondary to a dilatation of the vein walls, the venous blood is stagnant or flows in the reverse direction. Particularly is this true in those veins in which the result of the Trendelenburg test with von Perthes modification is positive or double (Fig 7).

This phenomenon—Trendelenburg sign—merely demonstrates that the valves of the saphenous vein are incompetent (Trendelenburg positive), or that the valves in both the saphenous and in the communicating vein are incompetent (Trendelenburg double) and, furthermore that the deep saphenous system is competent and functioning.

In his thesis Bernstein (1) has shown that in the early and beginning varicosities the Trendelenburg sign is nil in 71 per cent, in the advanced or moderately advanced cases the Trendelenburg sign is positive in 40 per cent, and nil in 30 per cent. We, however, have been unable to confirm Bernstein's findings of 71 per cent Trendelenburg nil in early varices, although we have seen a few such cases.

Practically all of our cases, although many of them had small varices, have shown a Trendelenburg positive, negative, or double sign. These findings indicate that the incompetency of the valves is not the sole causative factor in the production of varicosities. Bernstein has also proved by an extensive examination of gross specimens of varicose segments removed at operation that his demonstrations of the various Trendelenburg signs were founded on pathological findings.

It has been our aim to demonstrate and confirm these findings in the living subject. With the aid of the fluoroscope we believe that we have been able to do so.



Fig. 1 The second injection of 1 cubic centimeter of lipiodol about the point of the needle with the first 0.5 cubic centimeter progressing down the saphenous vein after repeated straining. As long as the patient was motionless the globules remained stationary.

#### ANATOMY AND PHYSIOLOGY

The normal anatomy of the superficial and deep veins is well described in any standard textbook of anatomy.

The salient features in relation to the subject in question may be of interest here. The deep veins are placed among the muscles of the leg, thus their vein walls are well supported. The muscular contractions of the leg in walking exert a constricting effect on the veins of the deep system and with a pump-like action force the blood upward in these veins which are equipped with valves to prevent a reverse flow. The superficial veins lie in the superficial fascia just under the skin with nothing more for support. They, too, are equipped with valves. To aid in the expulsion of blood from these veins, there are the valves plus the aspiratory effect of respiration, as described by Bernstein (1) and Hallion (3) and the aspiratory action of the pelvic veins. Between the superficial and the deep veins are the anastomosing communicating veins likewise equipped with valves facing in the direction of the deep circulation. Thus in a normal person it is possible for the blood to pass from the superficial veins to the deep system but not ordinarily in the reverse direction. If the Trendelenburg sign is negative or double, this reverse flow from the deep to the superficial system will be possible.

In the normal person there are three things which aid in the progress of the blood from the veins of the lower extremities: (1) the

muscular activity of the legs with its contractile effect which forces the blood upward, (2) the negative pressure within the abdominal cavity which is produced by the raising of the diaphragm in expiration and which tends to aspirate the blood from the lower extremities and (3) competent valves which prevent the onward flow of blood from dropping back.

#### PATHOLOGICAL

The exact etiological factor in the production of varicose veins is not yet definitely determined nor do we believe that one single factor will ever be found to be the sole cause. We believe that a hereditary tendency is a prominent predisposing factor and that a low grade infection of the vein wall plays a great rôle in many cases. We do not fail to recognize the influence of glandular changes, occupational stasis, intra abdominal tumors and pregnancy, although in most of these we have been able to trace a hereditary tendency or focus of infection.

For convenience we have arbitrarily designated four different sizes of varicose veins

Size	Diameter in centimeters
1	Up to 0.5
2	From 0.5 to 1
3	From 1 to 1.5
4	1.5 to 2 or more

Those varices larger than 2 centimeters are usually aneurismal and saccular in type.

In varicose veins as in any other pathological condition it is natural to presume that the normal function is disturbed and the



Fig. 2 The lipiodol is passing down the saphenous vein under the force of mild abdominal exercise and passive movement of the leg.

more extensive the disease the greater the disturbance in function

In beginning varicosities 71 per cent have competent valves according to Bernstein's figures. We presume, however, that the aspiratory effect upon the blood in the enlarged varicose vein is not sufficient to draw this greater volume of blood from the enlarged vein, rather, it would be easier for the blood to pass through the communicating and into the deep veins where the flow is more normal as is demonstrated by the Trendelenburg positive, double or negative sign or to remain practically stationary as in the Trendelenburg nil sign gradually draining backward through the valves as the pump like action of the muscles on the deep veins forces the blood out from the veins below. As the veins become more dilated the valves become less effective and the reverse flow more pronounced. The positive intra abdominal pressure during inspiration tends to retard the flow of blood from the superficial veins and later, after the valves have become incompetent, actually to increase the reverse flow.

We have observed under the fluoroscope that inspiration caused a definite reflux in a saphenous vein where the valves were incompetent but that expiration, contrary to what we originally anticipated, caused no aspiratory effect in the enlarged varicose veins whereas in the deep set of veins this aspiratory effect was definitely in evidence. We have also observed under the fluoroscope that muscular exercise produced a definite pump like action

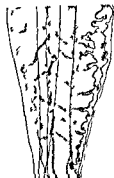


Fig. 4 After further active exercise the globules are seen to scatter widely throughout the deep system of veins and are progressing centralward through the deep veins. None was seen to pass upward through the superficial saphenous veins.

drawing the blood from the superficial varicose veins through the communicating veins and forcing it upward through the deep saphenous system. None was seen to pass up through the superficial saphenous vein.

The following cases which have been studied under the fluoroscope will clearly demonstrate our contention.

**CASE 1** The patient had had varicose veins (size 4) for 10 years. They caused her considerable discomfort. The veins extended from the midportion of the thigh to the ankle in a continuous tortuous mass of varicosities. The Trendelenburg test showed a positive sign with von Perthe's modification, indicating that the valves of the superficial saphenous were incompetent but that the valves in the communicating and deep veins were functioning, so that during muscular exercise of the leg the blood from the superficial varicose veins was pumped up through the deep circulation.

With the aid of the fluoroscope we attempted to determine the course of the injected fluid in the saphenous veins. We injected 1 cubic centimeter of lipiodol into the upper limit of the varicose saphenous vein and then observed its progress under the fluoroscope taking X ray exposures at various stages. We have outlined the saphenous vein on the X ray plates so that it can be more readily identified.

The first fluoroscopic exposure was made with the patient relaxed in a reclining position and showed the lipiodol being injected from the point of the needle. While the patient remained quiet the solution remained stationary about the point of the needle. She then raised her head and with this small amount of exertion of the abdominal muscles and consequent increase in intra abdominal pressure the solution was seen to break up into several particles and move quickly downward. With the relaxation of her head the fluid was seen to fluctuate back. Repeated raising and lowering of the head caused



Fig. 3 The globules of lipiodol are seen in the leg passing from the superficial into the deep system through the communicating veins. This is the result of active exercise of the leg muscles.



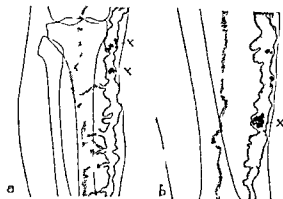


Fig 5 Repeated movements of the leg and expiratory exercises have drawn most of the globules upward through the deep system of veins with only small groups of globules remaining. The group marked x appeared to be confined in an aneurism along the course of the main veins where they swirled about on active exercise.

the globules of lipiodol to break up into numerous particles and to pass farther downward below the knee joint.

She was then asked to raise her body into a semi-reclining position. With this motion the solution passed down the entire length of the saphenous vein. This demonstrates the reverse flow produced by the increase in intra-abdominal pressure alone. Repeated exercises of the abdominal muscles as described above succeeded in producing only a to-and-fro motion of the particles of lipiodol in the superficial saphenous vein and did not tend to make the particles pass through the communicating and into the deep circulation. We then had her move her toes and ankle back and forth thus producing exercise without force. With this motion we saw the globules of lipiodol dash into the communicating veins where they fluctuated back and forth with

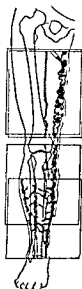


Fig 6 A composite drawing of Figures 1 to 5

each motion but they did not flow toward the heart until forceful exercise was produced by pushing the foot against the examiner's hand to simulate the muscular action of walking. During this exercise the globules of lipiodol were seen to move gradually centralward with each muscular exertion until finally they had disappeared completely by way of the deep veins of the leg. None was seen to go up through the superficial saphenous vein.

A similar experiment was carried out with Case 2 and as the plates in the case are typical of both cases we are using them to avoid duplication.

**CASE No. 2** Mrs. H. F. age 40 had large varicose veins (size 4) extending from her groin to the ankle in a continuous tortuous mass of varicosities. Trendelenburg sign was positive with von Perthes's modification. The patient was placed upon the fluoroscopic table in the sitting position with her legs extended horizontally. One half a cubic centimeter of lipiodol was injected into a large loop of vein in the upper third of the thigh and its progress observed under the fluoroscope pictures being taken at opportune intervals.

As long as the patient remained perfectly quiet the lipiodol remained in a solid mass about the point of the needle (Fig. 1). She was asked to strain as at stool producing a definite increase in intra-abdominal pressure. The globules of lipiodol passed downward about 6 inches (Fig. 2). Relaxation caused no reflux. Further straining scattered the globules and forced them farther peripheralward. One cubic centimeter more of lipiodol was injected

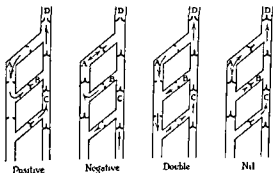


Fig 7 Diagrammatic sketches illustrating the condition of the valves in the various Trendelenburg signs as described by Bernstein. Note the direction of the venous flow. 1 Superficial saphenous vein B communicating veins C, deep system of vein D femoral vein.

and the same procedure produced similar results (Fig. 1). Muscular activity of the foot without force caused the particles of lipiodol to pass downward into the veins of the leg and into the communicating veins where they were seen to swirl around in aimless fashion (Fig. 3). One particle appeared to be caught in an aneurismal sac for it remained twirling constantly in one place as seen in all the plates in the mid thigh (see x Fig. 5). Forceful exercise of the calf muscles pushing against the resistant hand of the examiner in simulation of the action of walking caused the particles to pass into the deep system where they advanced toward the heart with each pump like action of the leg (Figs. 3, 4, 5).

During inspiration the globules in the superficial varicose saphenous veins were forced peripheralward about 1 inch. Those globules in the deep system remained stationary. This was the effect of intra abdominal pressure upon the valveless saphenous vein. Expiration with its negative intra abdominal pressure produced no change in the superficial varicose saphenous vein but tended to draw the particles centralward from the deep system of veins due to its aspiratory effect. With repeated inspirations we were able to aspirate the particle of lipiodol farther centralward through the deep system of veins but this had no effect upon the particles of lipiodol in the superficial veins.

We presume that the greater volume in the varicose veins is not influenced by the aspiratory effect within the abdomen during expiration. The blood, therefore follows the path of least resistance and passes downward through the communicating into the deep veins and then centralward where the physiological factors are more normal.

#### CONCLUSIONS

We believe that these experiments demonstrate and confirm the findings of Bernstein, which he obtained through extensive operative work in the surgical treatment of varicose veins.

In the early cases of varicose veins of the legs the valves in the saphenous vein may be competent and there is no reverse flow. In these there is merely a stagnation of blood. These demonstrate Trendelenburg nil

In the moderately advanced cases the valves have become deficient and the Trendelenburg test sign is positive with the blood flowing downward in the superficial saphenous and into the deep veins through the communicating veins, the valves of which are still normal.

In the advanced cases the valves in the communicating veins are also destroyed and the Trendelenburg sign is double.

This explains clearly how valvular incompetency in the great saphenous (Trendelenburg positive) plus the valvular deficiency in the communicating veins (Trendelenburg negative) gives the condition described as Trendelenburg double. In this condition we get a reverse flow from both the superficial and deep system of veins causing a stagnation of blood in the dependent extremity with a saturation of the tissues by blood serum. It is this saturation of the tissues that lowers their resistance and makes them so susceptible to infections and later ulcer formation, the dreaded end result of varicose veins.

We believe that in all varicose veins of the lower extremities, the circulation is either stagnant or reversed and that the chemically induced thrombus is forced distally toward the smaller and branching veins where it will most certainly be arrested.

We believe that until some more definite reason can be found to account for the rare development of emboli we must accept this as an explanation of their unusual occurrence.

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## THE BEHAVIOR OF GASTRIC ACIDITY IN DUODENAL ULCER AND PYLORIC OBSTRUCTION BEFORE AND AFTER GASTRO-ENTEROSTOMY

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**T**HOUGH the behavior of gastric acidity in duodenal ulcer is of practical as well as theoretical importance, and a great many studies have been made thereof, the factors governing it are still largely undefined. The assumption has been generally made, on purely theoretical grounds, that the so called hyperacidity frequently found in these cases is due to hypersecretion and that for some reason the gastric glands produce a juice of higher acidity than normal. Yet we have no evidence that such is the case. Indeed, the acidity of pure actively secreted juice is quite constant and, according to Pavlov and confirmed more recently by Carlson never exceeds a value equivalent to 0.5 per cent hydrochloric acid. The most "hyperacid" gastric contents may reach but never exceed this level.

Whatever the cause of high acidity or, indeed, variations in gastric acidity in general, it is a widely accepted observation that a lowering of acidity usually takes place following operations for the relief of duodenal ulcer, particularly gastro enterostomy and gastric resection. Many surgeons (8, 14, 16) have claimed that the success of such operations depends on the development of such a postoperative hypo acidity or even anacidity. It is, therefore, of the utmost clinical importance to study the mechanism by which this end is achieved. Some explanations have been offered if it is true. As will be pointed out below most of them are untenable.

Variations in the level of gastric acidity in the normal as well as in the diseased stomach are, according to the prevalent view, a matter of variations in the secretory activity of the gastric glands. Much evidence has accumulated in recent years to discount this idea and to support a conception first advanced by Boldyreff in 1911. This evidence has been presented and discussed in some detail in a previous paper (10). In brief, it is assumed that the high and constant acidity of the actively

secreted gastric juice is normally reduced to the lower acidity usually found in the stomach contents by some neutralizing mechanism and that this mechanism is one of reflux of the alkaline pancreatic juice into the stomach. Variations in this activity, then, would account for variations in neutralization and, hence, in the level of gastric acidity. Lesions about the pylorus, for example, either by spasm or by actual obstruction by ulceration, would lessen the duodenal regurgitation and thus account for the high gastric acidity so frequently found in these cases. In this paper observations of this sort have been made.

The degree of acidity produced by the stomach after a test meal, therefore, is here of relatively little interest. Countless observations of this kind have already been made in a wide variety of diseases, with many different forms of gastric stimuli, and, as shown by Bloomfield and Keefe, with rather limited value owing to the widely divergent findings among perfectly normal persons. The main object of this study is rather the rapidity and effectiveness with which acid, once secreted, is neutralized in the stomach. The device used to measure this neutralization consists of introducing an acid solution of the strength normally secreted by the gastric mucous membrane (0.5 per cent hydrochloric acid). Samples are withdrawn at intervals for analysis, and the degree and rapidity of its neutralization is thus measured. This acid test meal was originally devised for experimental animals by Boldyreff. It was used by Migay in a patient with a stomach fistula and by Apperly in normal persons.

## METHOD

The acid test meal, 300 cubic centimeters of 0.5 per cent hydrochloric acid solution, is introduced into the stomach through a small rubber tube fitted with a perforated metal tip such as is used for duodenal drainage. Samples are removed thereafter and titrated

against one tenth normal sodium hydroxide for "free" and "combined" acid using Toepfer's reagent and phenolphthalein as end points respectively

The usual routine for an Ewald test meal is used. Patients are allowed nothing by mouth after midnight preceding the morning of the test. During the test the patient is kept in a sitting position either in bed or in a chair. The tube, previously chilled by immersion in ice, is passed rapidly into the stomach until gastric contents are obtained which usually correspond to a mark on the tubing. This position is maintained during the rest of the test. In a few patients fluoroscopic examinations were made to check the position of the metal bulb in relation to the mark on the tubing to insure the presence of the tip in the most dependent parts of the fundus, since obviously, if the tube passes on to the duodenum, the test is of little value for purposes of this study.

The fasting contents are first removed, the acid solution given, and an immediate sample of 20 cubic centimeters withdrawn. Thereafter 20 cubic centimeter samples are aspirated every 20 minutes until specimens are no longer obtainable, or in any case, no longer than 2½ hours. The initial specimen serves to check the possible presence of unaspirated fasting contents. If its acidity is the same as the original solution it is assumed that no dilution with unaspirated fasting contents has occurred. To insure removal of a fair sample the syringe is filled and emptied several times, while attached to the tube, to mix the gastric contents thoroughly, and only then is the specimen aspirated for analysis. During the test the patient is instructed to expectorate all saliva so that swallowing of it will not contaminate the test solution. Titrations are carried out on the fasting contents, the initial and all succeeding samples, and their appearance is recorded particularly as to the presence of bile. From the acid values obtained a graph is plotted as will be described.

The acid solution is well borne in all cases without untoward effect. In one as noted in the clinical abstract below a reproduction of the patient's symptoms was provoked. This observation has been made recently by

Palmer who gives as a test solution 50 cubic centimeters of 0.5 per cent hydrochloric acid merely to elicit pain, which, if present, he considers of diagnostic value. Since, during the test, a large amount of acid is absorbed, 2 grams of sodium bicarbonate are given to compensate for it, as soon as the test is over.

Observations were first made on a number of normal individuals and on patients with no symptom or sign pointing to disease of the gastro intestinal tract. Patients with a variety of gastric disturbances were then studied, particularly those with duodenal ulcer, with and without actual pyloric obstruction. The diagnosis in each case was verified by careful roentgenological studies with the barium meal. In case of operation the test was repeated as soon thereafter as feasible and at various times after the patient left the hospital. Gastro enterostomy was the procedure carried out in every case of duodenal ulcer here considered. Fluoroscopic examinations with the barium meal were made 2 weeks after operation and at intervals thereafter to determine the functioning of the new stoma as well as the presence or absence of 6 hour residue. The cases of duodenal ulcer here presented were not selected, they represent consecutive admissions to the surgical service, most of them having first been studied by the internists and transferred as suitable subjects for operation.

#### EXPERIMENTAL FINDINGS

The results obtained are plotted graphically, the base line representing minutes after the introduction of the acid and the vertical line the titration values. The "total" acid values are used both in the normal controls as well as in patients with duodenal ulcer, since in nearly every case they parallel the "free" acid.

The normal curves are surprisingly uniform. They are represented together in Chart I and are to be compared with the findings in patients with duodenal ulcer, which are shown on the same chart. It will be noted that, in the normal, the graph is nearly straight and that within 80 to 100 minutes the stomach is empty, at which time the final sample has an acid value of between 20 and 40 degrees

*Delayed neutralization in duodenal ulcer and pyloric obstruction* In 9 patients with proved duodenal ulcer (as shown by operation) the type of curve is strikingly different. In them the acid solution is slowly and incompletely neutralized; that is, the curve is more prolonged. The emptying time is delayed, in no case to less than 120 minutes and in many much longer. The most marked delay as might be expected, is noted in those with pyloric obstruction (cases 11, 13, 16). The final samples show in no case an acidity under 50 degrees, in a few it is as high as 100. The composite results in the 9 cases are represented in Figure 1 for comparison with the normal curves. Brief clinical notes of each case are appended.

*The rapid neutralization following gastro enterostomy* The striking change noted in nearly every case following operation was prompt. In some the acid test meal was given within a week and the neutralization was complete within 60 minutes, the acidity being reduced to zero. Moreover, the samples always contained bile in contrast to the relative absence of it previous to operation. The findings are recorded graphically in Charts 2-7 showing the neutralization curve before and after operation.

Special mention is to be made of one case in which this rapid fall in acidity did not occur (Chart 1, Case 8). Fluoroscopic examination showed a non-functioning stomach in contrast to the patent opening in the other cases. It is too early yet to determine whether this patient will have a recurrence of symptoms.

#### DISCUSSION

While the number of cases studied is not large, the findings are uniform and fairly constant. In brief, they indicate a perversion of the gastro-intestinal mechanism in patients with duodenal ulcer so that using the acid test meal neutralization of gastric acidity cannot be accomplished so completely or so quickly as in the normal stomach. This is most marked when there is more or less severe obstruction at the pylorus. The acid solution used as the test meal moreover remains in the stomach longer—the emptying time is often prolonged to twice the normal

value. Following gastro enterostomy the mechanism changes almost at once—neutralization occurs very rapidly and completely, and the stomach empties itself of the acid solution in about a third of the time previously necessary. Finally, the gastric contents, free of admixture with bile before operation, now come to contain it constantly.

Certain inferences may be drawn from the findings particularly since they have an important bearing on the question of the mechanism by which high gastric acidity is frequently maintained in duodenal ulcer and indeed in many cases in which only a pyloric spasm can be demonstrated. The presence of the ulcer either actively by spasm or passively by scar contraction leads to a dynamic or actual pyloric obstruction thus preventing reflux of pancreatic juice and defeating its purpose as the main neutralizing agent of gastric acidity. It is true that low instead of high acid values are usually found in cases of severe pyloric stenosis. Here however a secondary factor has come into play. The gastric retention and dilatation frequently of long standing have brought about an atrophy of the gastric mucous membrane which is therefore unable to secrete the high acid juice of the normal glands.

Consideration of the findings herein recorded moreover seems to throw some light on the mooted question of the type of operation best designed to develop a permanent postoperative hypo acidity which as seems generally agreed is clinically the end to be desired in the cure of duodenal ulcer.

The original basis for the operation of gastro enterostomy was that of drainage and since duodenal ulcer at that time was probably operated on only when far advanced to the stage of pyloric obstruction the assumption was a logical one. Even at the present time it is in cases of pyloric obstruction that gastro enterostomy achieves its most brilliant therapeutic results. It was soon found however that in cases with a patent pylorus this explanation did not hold for gastric contents did not always leave the stomach through the new stoma—as first shown experimentally by Cannon and Blake in dogs and by Schueller and others in humans as well.

In 1907 Katzenstein found that following gastro enterostomy there was nearly always a lowering of gastric acidity, a finding recorded at about the same time by Willcox and since then repeatedly confirmed by a great many observers (4). Katzenstein maintained that this was the essential effect of gastro enterostomy and explained it by assuming that bile and pancreatic juice entered the stomach through the new stoma more readily and thus neutralized the gastric acidity more effectively. In support of this contention he presented analyses of the stomach contents in which trypsin, a ferment characteristic of pancreatic juice, was constantly present. Others explained the low acidity after gastro enterostomy by some sort of reflex inhibition of gastric secretion. The experiments of Steinberg, Brougher and Vidgoff definitely seem to invalidate this idea. They made a Pavlov pouch and a gastro enterostomy in a number of dogs and found that the acidity of pure juice from the isolated pouch is always unchanged, though that of the contents of the main stomach is much lower than normal.

Explanations of the mechanism following gastric resection have been quite different. Most observers agree that the gastric acidity following this operation is lower and persists longer than is the case with gastro enterostomy (4, 28). One meets frequently the statement that this is so because in gastric resection the "acid bearing portion of the stomach" is removed. This is apparently due to a misapprehension, for the pyloric portion of the stomach is really the only part of the stomach which contains *no* acid cells (15). Indeed, its secretion is slightly alkaline (11). To remove the "acid bearing portion of the stomach" would require a total gastrectomy, for acid cells are found over the entire fundus up to the very cardiac orifice (15). Schur and Maschkes varied this theory by contending that gastric resection leads to hypo acidity because the resected pyloric antrum contains the so called gastric secretin or gastrin first extracted from the mucous membrane of this portion of the stomach by Edkins. This hormone is supposed to be the normal stimulant of gastric secretion, so that removal of

its source, they maintained, diminishes the amount of gastric secretion. Attractive as this explanation is, subsequent evidence has rendered it invalid. Thus, Keeton and Koch showed that gastrin can be obtained not only from the pyloric antrum but is found in even slightly greater concentration in the mucous membrane over the fundus and cardia as well. By direct experiment Steinberg has in another way shown that gastric resection does not inhibit gastric secretion. He found no alteration in the gastric juice flowing from a Pavlov pouch in dogs following resection of the stomach. Portis and Portis performed the same experiment with the same finding.

Evidence of another sort has shown, moreover, that the low acidity following gastric resection is dependent on the intimate communication between duodenum and stomach. If the duodenum, for example, be transplanted so that its contents empty into the lower ileum, the behavior of acid in the stomach after resection suffers a severe change. Steinberg in extensive experiments on dogs, first confirmed the finding of low acidity after gastric resection with the Ewald meal and then demonstrated a very rapid neutralization of an acid test meal. He then transplanted the duodenum into the lower ileum so that pancreatic juice could not readily enter the stomach. The gastric acidity after this procedure was no longer low either in the fasting content or after the Ewald meal, and neutralization of the acid test meal was incomplete and prolonged.

Experimental diversion of the duodenal contents in this way was first used by Mann and Williamson and the operation was called "surgical drainage of the duodenum". Of especial interest is the finding of Morton that, following this operation peptic ulceration is very frequent, if pieces of gastric mucous membrane be removed there will develop in the areas thus excised chronic and perforating ulcers while healing takes place rapidly when the same thing is done in the intact control animal. Unfortunately, no studies on gastric acidity were reported. In our experiments on the total drainage of pancreatic juice, one instance of extensive and severe ulceration of the gastric mucous membrane was

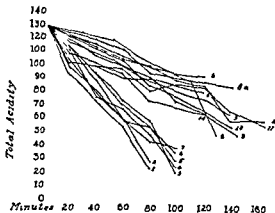


Chart 1 Composite graph showing neutralization curves after administration of the acid test meal in normal controls (lower curves Cases 1 to 7) and in patients with propped duodenal ulcer or pyloric obstruction (upper curves Cases 8 to 16)

observed. The entire secretion of the pancreas had been drained to the outside for 6 days before death, and the gastric contents were much more acid than normal (100 to 140 degrees). At autopsy a most remarkable erosion of fully half of the fundus was seen involving all of the mucous membrane down to the muscularis, with tenacious strings of mucus clinging to the edges and a shrinking of the base from muscular contraction. This finding was not repeated, but on going over the protocols it was found that in this case a large stomach tube had been used in obtaining gastric contents, whereas in the other instances a small duodenal tube was employed. The explanation seemed to point to the trauma of the large tube as the obvious cause. More extensive experiments would seem advisable to test the behavior of artificially produced ulcers after removal of the total external secretion of the pancreas.

The surgical problem of duodenal ulcer, then according to the evidence herein presented, must concern itself with the means best designed to allow pancreatic juice to enter the stomach. Since this takes place through the pylorus it would seem that the surgical attack would best be made at this point. Faulty neutralization occurs because of pyloric obstruction, most commonly a dynamic one due to spasm. Which of the various surgical procedures best promotes

neutralization can be determined only by experiment. In the case of many of them, Olch has found that the Finney pyloroplasty best achieves this end, but no clinical studies have as yet been made after this operation, particularly in parallel with cases of gastric resection and gastro enterostomy, and indeed with the other operations used and advised by various surgeons for the cure of duodenal ulcer.

The cases of gastro enterostomy herein presented certainly show a prompt and effective reduction of gastric acidity, the "acid test meal" frequently being neutralized completely within 60 minutes and in some within 40 minutes. The one failure, however, indicates that the operation may have more limitations than is supposed. All of our patients are being traced and examined from time to time as to the patency of their stoma, the rate of acid neutralization, and clinical freedom from symptoms. According to Bohmannson who has reviewed the literature, postoperative hypo acidity following gastro enterostomy is not permanent. Devine, who has followed up many cases of gastro enterostomy has noted that a number suffer recurrence of symptoms and that all of them on examination show a return of the hyper acidity found before operation. There is a great deal of variability in all reports on gastric acidity, part of which may be due to the variety of gastric stimuli used as test meals. But they all aim to measure the acidity developed in the stomach after a given stimulus. From the evidence reported herein the more important factor would seem to be the measurement of the rate of acid neutralization by means of the acid test meal described. With it a different and, it is believed, a more valuable picture of gastric physiology in the various operative procedures can be obtained. Further observations along this line are now in progress.

#### CLINICAL ABSTRACTS

##### Normal Controls

CASE 1 Male, aged 33 years. No gastric or other complaints.

CASE 2 Male aged 52 years. Vague epigastric distress of indefinite nature. X ray showed questionable filling defect in pars pylorica. Laparotomy

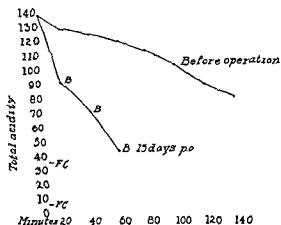


Chart 2 Case 10 Pyloric obstruction Neutralization curves before and after gastro-enterostomy Presence of bile *B* in stomach and decrease in acidity of fasting contents *F C* following operation is also indicated

revealed nothing abnormal Gastrotomy showed no lesion of interior of stomach Recovery uneventful

CASE 3 Male, aged 27 years Hernia of several years duration

CASE 4 Female, aged 42 years History of pain and discomfort in right upper quadrant Cholecystectomy for chronically inflamed gall bladder was performed Stomach found normal at operation and by X ray

CASE 5 Male, aged 36 years Central nervous system lues with no active symptoms at present

CASE 6 Male, aged 30 years No gastric or other complaints

CASE 7 Male, aged 25 years Hernia of 2 years duration

#### Duodenal Ulcer and Pyloric Obstruction

CASE 8 Female, housewife aged 33 years History of intermittent attacks of right upper quadrant pain every week or two for past 6 years in increasing in severity and associated with tarry stools and attacks of vomiting X ray shows deformity of duodenal cap with no 6 hour retention The cholecystograms were normal Patient sent home with dietary regimen Neutralization test at this time (Chart 1 8) showed no bile in any specimen, no reproduction of symptoms marked delay in neutralization Fasting contents were 50 cubic centimeters Patient returned in 7 months with accentuation of symptoms in spite of the fact that she had carefully followed her dietary regimen She now had tenderness and sharp pains in the epigastrium X ray pictures showed barium outside a deformed duodenal cap indicating perforation but with no evidence of peritoneal irritation White blood count 8000 Acid test meal showed an even greater delay in neutralization (Chart 1 8a) and this time a marked reproduction of patient's symp-

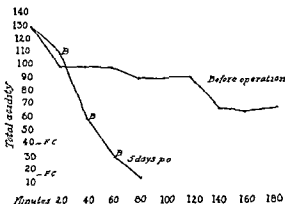


Chart 3 Case 11 Pyloric obstruction Neutralization curves before and after gastro-enterostomy Presence of bile *B* in stomach and decrease in acidity of fasting contents *F C*, following operation is also indicated

toms of pain One week after admission a gastro-enterostomy was performed The ulcer was found adherent to the pancreas The gall bladder and liver looked normal Neutralization tests 5 days and 14 days after operation showed no change in the curve Barium fill up showed that stoma was not functioning Symptoms seemed relieved on discharge from hospital but has not been heard from since

CASE 9 Male physician aged 28 years History of several years of epigastric distress and pain relieved by soda and food X ray diagnosis of duodenal ulcer 2 years ago There has been some relief with dietary treatment but still has occasional discomfort after meals Acid test meal caused no reproduction of symptoms no bile in specimens, fasting contents of 25 cubic centimeters Moderate delay in neutralization (Chart 1 9) Appendectomy 5 months later at which time the pylorus was searched for and seen with some difficulty without making out any evidence of ulcer

CASE 10 Female, housewife aged 59 years History of bloating belching, pain in right side for 20 years, associated with attacks of vomiting which became severe in past few weeks On admission she was dehydrated and undernourished X ray showed a small duodenal cap contracted and deformed with moderate 6 hour retention Cholecystogram showed no shadow Patient discharged with dietary instructions She was readmitted to the hospital 1 month later with the complaint of constant vomiting for past week Neutralization test showed 20 cubic centimeters fasting residual (total acidity 35), no bile in any sample and marked delay in neutralization of acid test meal (Chart 2) Operation was performed 2 days later and a contracted gall bladder which was firmly adherent to and obstructing the pylorus, was removed A gastro-enterostomy was also performed The postoperative course was uneventful Acid test meal 12 days after operation showed 10 cubic centimeters fasting contents (total



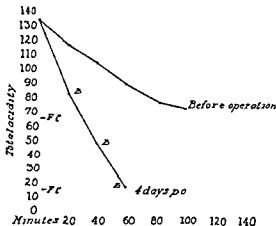


Chart 4 Case 13 Duodenal ulcer Neutralization curves before and after gastro-enterostomy Presence of bile *B* in stomach and decrease in acidity of fasting contents *F C* following operation is also indicated

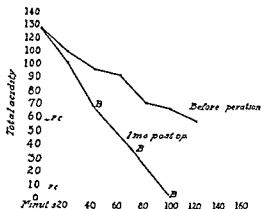


Chart 5 Case 14 Duodenal ulcer Neutralization curves before and after gastro-enterostomy Presence of bile *B* in stomach and decrease in acidity of fasting contents *F C* following operation is also indicated

acidity of a rapid neutralization and bile in all samples Barium fill up showed a well functioning stoma with no 6 hour retention Clinically patient has remained well

CASE 11 Male mechanic aged 5 years Meager history of gradually increasing vomiting for past 6 months Two weeks before admission X ray picture had shown marked 6 hour retention lengthening and narrowing of duodenal cap Cholecystogram showed no shadow After admission an acid test meal revealed pronounced delay in neutralization with 200 cubic centimeters still remaining after 2½ hours Fasting residual of 450 cubic centimeters (total acidity 40) The patient was somewhat drowsy and weak non protein nitrogen 166 milligrams per 100 cubic centimeters Phenolsulphonphthalein excretion 5 per cent in 2 hours Parenteral fluids were given with high caloric liquid feedings and in 14 days non protein nitrogen and phenolsulphonphthalein became normal and general condition was markedly improved At operation 2 days later a small mass was found at the pylorus attached to the pancreas and having a crater at its center The gall bladder was thickened and gray Gastro enterostomy was performed with an uneventful recovery The acid test meal 6 days after operation showed a rapid neutralization (Chart 3) and bile in all samples Fasting contents were 100 cubic centimeters (total acidity 10) Barium fill up showed poorly functioning stoma and some retention at 6 hours Patient was seen 1 and 3 months after operation showed same rapid neutralization of acid meal, and remained quite free of symptoms

CASE 12 Minister aged 50 years History of 2 years duration with burning and eructation after meals relieved by vomiting Symptoms were intermittent and were less severe with careful diet Gastric analysis showed 50 cubic centimeters fasting residual with total acidity of 12 X ray picture

showed moderate 6 hour retention and deformity of duodenal cap characteristic of old quiescent duodenal ulcer On rest and diet patient improved rapidly Neutralization test showed definite delay in fall of acid titration and increased emptying time (Chart 1 12)

CASE 13 Salesman aged 36 years History of periodic attacks of vomiting of 10 years duration becoming more and more severe and associated with tarry stools He has had to be very careful of diet X ray examination showed marked retention obstruction at pylorus and lengthening and narrowing at the ring Cholecystogram showed a small dense persistent shadow Neutralization test revealed 120 cubic centimeters fasting residual with total acidity of 64 The acid solution was neutralized incompletely and slowly so that at the end of 2 hours total acid was 90 and 200 cubic centimeters of fluid were still in the stomach At operation, 8 days after admission dense scarring at pylorus was found The stomach was markedly dilated and the gall bladder looked normal but was attached to the scarred pylorus A gastro enterostomy was performed with good recovery Five days after operation a small tube was passed into the stomach and only 20 cubic centimeters of bile stained fasting residual was obtained with a total acidity of 20 The acid test meal was given and complete neutralization was effected within 60 minutes at which time the stomach was empty Every specimen was bile stained (Chart 3) Barium fill up 2 weeks later showed a functioning stoma and no 6 hour retention

CASE 14 Janitor aged 50 years History of belching pain nausea and vomiting after meals for past 2 years Attacks have been getting worse although there were weeks of complete relief Three weeks ago pain became more severe and vomiting occurred every day at 4 o'clock Gastric analysis revealed 100 cubic centimeters of fasting residual

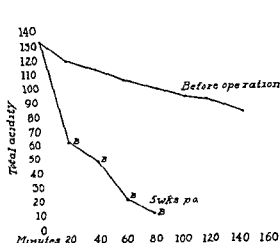


Chart 6 Case 16 Pyloric obstruction and gastrojejunal ulcer. Neutralization curves before and after operation. Presence of bile *B* in stomach is also shown.

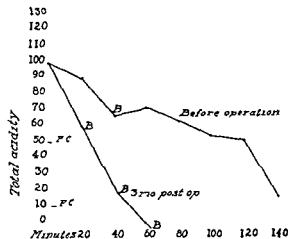


Chart 7 Case 17 Duodenal ulcer neutralization curves before and after gastro-enterostomy. Presence of bile *B* in stomach and decrease in acidity of fasting contents *F C* following operation is also indicated.

with total acidity of 35. X-ray examination showed marked retention and deformed duodenal cap with lengthening of pyloric ring. The cholecystogram showed a normal shadow. Acid test meal showed marked delay in neutralization and prolonged emptying time (2½ hours). Operation was performed 3 days after admission and a scarred pylorus was found. The gall bladder was normal in appearance. Gastro-enterostomy was performed with an uneventful recovery. The acid test meal 10 days after operation showed a more rapid rate of neutralization which on subsequent tests several weeks later revealed an increasing improvement in this test (Chart 5). Barium fill up 5 weeks after operation showed freely functioning gastro-enterostomy stoma but definite though slight gastric motor insufficiency moderate gastrectasia persisting.

CASE 15 Laborer aged 28 years. History meager pain and discomfort in epigastrium for several years. X-ray picture showed definite evidence of duodenal ulcer which was verified at operation. A gastro-enterostomy was done with recovery but complicated by a moderate wound infection. The acid test meal was given before operation and showed a prolonged emptying time and delayed neutralization (Chart 1). The patient would allow no tests to be made after operation.

CASE 16 Male laborer colored aged 51 years. History of pain in epigastrium for past 2 years and of vomiting for past 2 months. Thirteen years before he had had similar symptoms and a gastro-enterostomy was performed for pyloric stenosis due to duodenal ulcer. After freedom from pain for 7 years symptoms returned and X-ray examination showed a deformity at the stoma suggestive of gastrojejunal ulcer. Relief was obtained with dietary care and gastric lavage until 2 years ago. On admission this time X-ray picture showed marked

retention obstruction at pylorus a non functioning stoma and a deformity in the pars pylorica suggestive of gastrojejunal ulcer. Neutralization test 2 weeks later showed no fasting residual (vomit of several hundred cubic centimeters recorded previous to test). Neutralization was delayed (acidity reduced from 134 to only 94 in 2 hours) and emptying time prolonged. Four days later operation was performed. A gastrojejunal ulcer perforating into the mesocolon and pancreas was found. The pylorus was occluded by scar. The old stoma was resected the jejunum was resutured and a re-anastomosis of the stomach to the jejunum lower down was performed. Recovery was uneventful. Ten days after operation the acid test meal was given. There were no fasting contents the emptying time was rapid (60 minutes) and neutralization was complete. Bile was present in all samples (Chart 6). Clinical improvement has persisted for over a year and repeated examinations showed the same rapid neutralization and X-ray examination shows a functioning stoma with no 6 hour retention.

CASE 17 Male carpenter aged 41 years. History of pain 2 to 3 hours after meals relieved by food. Frequent tarry stools. Onset 7 years ago and becoming worse. X-ray examination 1½ years before admission showed no 6 hour retention but a deformity of the duodenal cap. A dietary regimen was tried for over a year with no improvement. On admission X-ray picture showed marked 6 hour retention and a gross filling defect in duodenal cap causing obstruction. Cholecystogram was normal. The acid test meal was given and revealed 100 cubic centimeters of fasting contents with total acidity of 50. There was a marked delay in neutralization and increase in length of emptying time. Operation was done 5 days later and showed an indurated ulcer at the pylorus causing obstruction. The gall

bladder was normal in appearance. A gastro enterostomy was performed with uneventful recovery. Three months later the patient had gained 15 pounds in weight and was free of symptoms. Neutralization test showed an emptying time of 60 minutes and complete neutralization at the end of this time. Bile was present in every sample (Chart 7). Barium fill up showed functioning stoma and no 6 hour retention.

A note was made that "there seemed to be a mechanical obstruction at the proximal loop resulting in a marked churning phenomenon in the duodenum with constant regurgitation of contents into stomach. This fits in with the specially rapid neutralization. The patient has been seen every 3 months since operation for over 1 year and remains free of symptoms and the gastric contents have remained hypo acid.

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CARCINOMA OF THE FUNDUS OF THE UTERUS<sup>1</sup>

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THE increase in the incidence of carcinoma of the fundus of the uterus within the last few years has been noted by various writers. The same factors which have played a part, at least, in the increase in carcinoma in general during the last decade apply to the increase in the number of cases of carcinoma of the fundus of the uterus, namely (1) increase in life expectancy, bringing a greater number to the "cancer age," (2) increased knowledge among the laity of early symptoms of carcinoma of the uterus, and (3) the more frequent examinations of the pelvis and the more accurate diagnoses made by the family physician.

Carcinoma of the fundus and carcinoma of the cervix occurred in a ratio of 1 to 3.4 in a series of 855 cases of carcinoma of the uterus reported by Mahle in 1919. Cullen reported carcinoma of the fundus in 25 per cent of 176 cases of carcinoma of the uterus, and Graves, 22 per cent in 550 cases, in most of the earlier textbooks it is stated that carcinoma occurs in the cervix eight to ten times as commonly as in the fundus.

Carcinoma of the fundus of the uterus has been considered a disease of postmenopausal life, but as in cases of carcinoma elsewhere in the body, recent studies show a greater incidence in younger persons than was shown in earlier reports. Graves considered it "for the most part a disease of atrophy." Three hundred and thirty-three cases of carcinoma of the fundus of the uterus in which operation was performed at The Mayo Clinic between the years 1907 and 1923 inclusive were studied. Two hundred and eleven (63.36 per cent) of the 333 women had ceased to menstruate. One hundred and eighty-six (55.85 per cent) of this number were between the ages of 50 and 59 years inclusive, 64 (19.21 per cent) were between the ages of 60 and 69 inclusive, and 13 were more than 70, the oldest patient being 77. Thirty-five patients (10.51 per cent) were between the ages of 45 and 49 years inclusive and 35 (10.51 per cent) were

less than 45, the youngest being 19. Thus it will be seen that carcinoma of the fundus of the uterus occurs in a fairly large number of women less than 50 years of age.

Uterine myoma or polyp, acting as chronic irritation, may be an etiological factor (as is almost universally believed) in carcinoma of the body of the uterus, for in the group of cases presented here myoma was found during operation in 124 cases (37.23 per cent), and in 12 (3.6 per cent) myomectomy had been performed previously. It is generally conceded that myoma of the uterus occurs in from 10 to 12 per cent of all white women more than 35 years of age. It would seem that the symptoms are masked at times by myoma, as in those patients having symptoms for more than 5 years myoma occurred in 44 per cent, a considerably higher percentage than in those having symptoms for a shorter period. It would seem, too, that the myomata probably developed comparatively late in life, as 216 (72.97 per cent) of the 296 married women had had children, and 14 (4.72 per cent) had had miscarriages. In 31 cases intra uterine polyp were found at the time of hysterectomy, and in 17 cases (5 per cent) intra uterine and cervical polyp had been removed previously. It would seem that polyp of the fundus, like those of the rectum are prone to become malignant in contradistinction to the polyp of the cervical mucosa which rarely undergo carcinomatous change. In this series the carcinoma was on a polypus in 25 cases (7.5 per cent). In 5 cases adenomyoma was found, in one of these the carcinoma was situated on the adenomyoma.

Abnormal vaginal discharge, not bloody, was the first symptom noted in 41 cases (12.31 per cent) and metrorrhagia and watery discharge occurred simultaneously as the first symptom in 47 cases (14.11 per cent). Metrorrhagia occurred in 283 (85 per cent) of the 333 cases and was the first symptom noted by the patient in 212 cases (63.66 per cent). Eighty-one (66.39 per cent) of the 122 women who

<sup>1</sup> Read before a joint meeting of the Chicago Medical Society and the Chicago Council of Medical Women, Chicago, December 12, 1928.

TABLE I—SUMMARY OF DATA IN THREE HUNDRED SIX CASES IN WHICH A DEFINITE TIME OF ONSET OF SYMPTOMS WAS STATED

Duration of symptoms, years	Patients	Patients traced	Average age, years	Less than fifty years, per cent	Lived more than 5 years, per cent	Hysterectomy		Per cent					
						Abdominal, per cent	Vaginal, per cent	With extensive lesion	With associated myoma	With cancer on polypus	Living at last report	Died at last report	Died of malignancy
Less than 1	144	126	55.40	23.8	60.30	76.22	23.77	15.8	34.02	25.0	57.38	47.61	30.6
1-2	70	60	55.02	16.6	66.00	77.14	22.85	21.6	30.00	20.0	58.33	41.66	31.6
2-3	34	28	50.17	3.5	64.29	85.29	14.70	42.8	41.70		50.0	50.00	42.8
3-5	33	29	54.57	6.8	66.50	87.87	12.12	28.2	30.30		48.27	51.72	37.8
Over 5	25	23	56.68	4.3	56.52	88.00	12.00	43.4	44.00	8.6	43.47	56.52	47.8
													4.10

had not ceased to menstruate reported irregularity of the periods, and 40 (12.01 per cent) menstruated profusely.

A patient giving a history of metrorrhagia or of an abnormal vaginal discharge should have a thorough examination to determine the cause of the symptoms before treatment is instituted. If palpation and visualization of the cervix do not show evidence of disease, and if the symptoms are rather indefinite, curettage for diagnosis should be done under anesthesia. If microscopic examination of the tissue removed shows the presence of carcinoma, hysterectomy should follow under the same anesthesia. Hysterectomy is better done without preliminary curettement and should be done in the face of negative curettage if the symptoms are definitely those of malignancy and the patient is a good surgical risk. Occasionally a small area of carcinoma in an early case is missed by the curette and a diagnosis of non-malignancy is made to be corrected later by the clinical history of the patient.

Before menopause a submucous myoma may cause metrorrhagia and in most instances hysterectomy is indicated rather than the use of radium. In The Mayo Clinic we feel that radium has not given satisfactory results in the treatment of submucous myoma. After the menopause, pyometritis may produce a foul and bloody discharge, usually more purulent than bloody, and the uterus is more often tender on palpation than if carcinoma is present. Curettement in such cases is contra-indicated, hysterectomy is the treatment of choice unless there is definite contra-indica-

tion to operation. Occasionally a patient with hypertension will have metrorrhagia, but a diagnostic curettage should be done before the arteriosclerosis is assumed to be the cause of the metrorrhagia and the patient should be carefully watched, if the symptom does not disappear with lowering of the blood pressure. Operative procedures should be considered. A preliminary curettage was performed on 38 patients, and 13 (34.21 per cent) died of recurrence and metastasis, 11 died within 5 years after operation and 2 lived 5 and 6 years respectively. Twelve patients were given intra-uterine radium treatment previous to hysterectomy. Five of the patients were poor surgical risks because of obesity or a heart lesion, and radium was given while the patient was being prepared for operation. Five patients had been given radium elsewhere a few months previous to the examination and operation at the clinic. Two patients were given radium for uterine myoma, one 2 years previous to the operation and one received two treatments 7 years and 2½ years previously.

Three hundred and six histories, in which the time of onset of symptoms was definitely stated, were studied to determine the relation of the duration of symptoms to the extension of the disease, the type of operation performed and the postoperative duration of life. The result of this study is shown in Table I. It is interesting to note that 144 (47.05 per cent) of the 306 patients sought medical advice during the first year of symptoms, and it is also noted that a greater per-

TABLE II—DURATION OF LIFE AFTER HYSTERECTOMY FOR CARCINOMA OF THE FUNDUS OF THE UTERUS, 1907 TO 1923 INCLUSIVE

Year	Patients	Deaths in hospital	Patients not traced	Duration of life years															
				Less than 1 year	1 to 2	2 to 3	3 to 4	4 to 5	5 to 6	6 to 7	7 to 8	8 to 9	9 to 10	10 to 11	11 to 12	12 to 13	13 to 14	14 to 15	15 to 16
1907	8		3	1 <sup>a</sup> 2	1														1
1908	10		1	2					1									1	5
1909	14		2	1 2														1	4
1910	22	2	1	1 4	1	1 1		1			1		1	2	1	4		1	
1911	8	3				1		1				1				1	2		
1912	11	1		3	1	1							1	1		1		1	
1913	19	1		1 2	1	2	1					1	1	1	1	1		1	
1914	19	2	1	2	1	1	1				1				2	2 6			
1915	16	1	1	1	1	2	3					1						6	
1916	22		1	1	4	2 1									1	10			
1917	26		2	1 1	1 4					1	1	1		12					
1918	24	1	4	1	1	1	1	1	1					2	3				
1919	31		3	1		3		1	1 <sup>a</sup> 1	3	1	1 13	2						
1920	33	4	3	4	2	3			1	1	14	2							
1921	35	1	3	4	1	1	1			1 14	4								
1922	17	1	1			1			9	4									
1923	23	1	2	3	1				15										
Total	333	18	27	40	27	23	9	6	25	21	19	15	9	16	26	11	11	11	11

<sup>a</sup>La use 1 last report 155 (53 per cent of 33)

Died from cause other than malignancy 21 (55 per cent) of 33 dead

Cause of death unknown 11 (31 per cent) of the 33 dead

centage of these patients were less than 50 years of age than in the other groups, and that the growth was considered grossly extensive by the surgeon at operation in only 15.8 per cent of the cases in the group, while in those in which symptoms had existed for 1 or 2 years the growth was noted as extensive in 21.6 per cent. In those in which the symptoms had existed for from 3 to 5 years, it was extensive in 28.2 per cent. In those in which symptoms had existed for more than 5 years the growth was extensive in 43.3 per cent.

However, in the 126 patients traced, who had had symptoms for less than one year 60.3 per cent lived more than 5 years and 39.6 per cent of the total number of this group

had died of malignancy at the time of the last report. Of those who had had symptoms more than 5 years 56.52 per cent lived more than 5 years 47.8 per cent of the entire group having died of malignancy at the time of the last report.

It is difficult to explain the statistics of the second group of cases, in which symptoms had existed for from 1 to 2 years since 66 per cent of the 60 patients traced lived more than 5 years and 41.66 per cent are dead, 31.6 per cent having died of malignancy at the time of the last report. The average postoperative life of those who died was 3.85 years. In the group of 26 patients traced of the 34 who had had symptoms from 2 to 3 years, a slightly

smaller percentage lived more than 5 years, and the average postoperative life of those who died was 3.59 years. In the group of 25 patients traced of the 33 who had symptoms from 3 to 5 years, 66.5 per cent lived more than 5 years, and 51.72 per cent had died at the time of the last report. Thirty-seven and eight tenths per cent died of malignancy and the average duration of postoperative life was 4.36 years, an increase over the postoperative life of those having had symptoms for a shorter time. In the group of 23 patients traced of the 25 who had had symptoms for more than 5 years, 56.52 per cent lived more than 5 years and 56.52 per cent were dead at the time of the last report, 47.8 per cent (more than in any other group of shorter duration of symptoms) died of malignancy and in this group the postoperative life was 4.2 years longer than among those having had symptoms for less than 3 years.

An attempt has not been made in this study to determine the grades of malignancy, according to MacCarty and Broders. Mahle in 1919, showed that there was a constant relationship between the grade of malignancy and the postoperative life, which probably would explain the short postoperative life of those patients who had had symptoms for the shortest length of time. The disease was considered grossly extensive by the surgeon at operation in 77 cases (23.12 per cent), the ovaries being involved in 26 cases and the tubes in 4.

It is impossible to determine the influence which the use of radium and roentgen ray may have had on postoperative mortality and length of life, as it has not been used as a routine postoperative treatment but only in those cases in which the growth was found to be extensive at the time of operation. In 1 group only have the patients treated with radium and roentgen ray outlived those not treated. These were the patients who had had symptoms for 2 and 3 years, 30.7 per cent died who had received radium treatment and 44.4 per cent of those not treated died.

The largest number of patients who died of recurrence died during the first 3 years after operation. A number of patients had recurrence after the fifth year, so it is suggested that the term "five year arrested cases" be

used rather than "five year cures." In the group of 333 patients operated on there were 18 postoperative deaths, an operative mortality of 5.4 per cent. Two deaths were due to pulmonary embolism. Of the 333 patients 288 were traced. One hundred and eighty-four (63.88 per cent) lived more than 5 years. Of the 172 heard from who had been operated on 10 years or more previously, 76 (44.18 per cent) lived 10 years, and of the 79 heard from who had been operated on 15 years or more previously 23 (29.11 per cent) lived fifteen years. One hundred and fifty-three patients of the total 288 heard from (53.1 per cent) are still living, all more than 5 years after operation. Of the 103 who died of the original disease, 63 died of local recurrence and 32 died of abdominal and other metastasis, in 8 there was metastatic lymphatic involvement as well as local recurrence. Twenty-one died of causes other than malignancy and in eleven the cause of death is not known. Table II gives in detail the postoperative results in the entire group of 288 patients heard from.

The postoperative results in cases of carcinoma of the fundus of the uterus have always been considered more encouraging than those following operation for malignant growth in the other commonly affected organs. Rankin, in 1927, reported the results following operation in 305 cases of carcinoma of the rectum and rectosigmoid, 103 (33.7 per cent) of the patients lived 5 years after operation. Eusterman found that of 222 patients heard from following operation for carcinoma of the stomach 56 (25.22 per cent) lived 5 years. In 827 cases of carcinoma of the breast with lymphatic involvement in which operation was performed Harrington found that 25.75 per cent of patients lived 5 years and of the 430 patients without lymphatic involvement 67.44 per cent lived 5 years. Thus in both groups five year arrested cases were obtained in 40 per cent.

In view of the foregoing data the 63.88 per cent of five year arrested cases bears out the frequently made statement that better results are obtained following operation for carcinoma of the fundus of the uterus than following operation on carcinoma of other commonly affected organs. This is probably due

to the protection afforded by the uterine muscle, which renders the growth less accessible to the lymphatics and explains the fact that 70 per cent of the patients who died of malignancy had local recurrence rather than metastatic malignancy.

Radium and roentgen rays have been used at The Mayo Clinic for only a small number of patients who were poor surgical risks and the results have been poor. If radium is used in amounts sufficient to destroy the carcinoma, ulceration of the healthy endometrium occurs and the mucosa of the bladder may be affected also.

#### CONCLUSIONS

1 Although carcinoma of the fundus occurs most commonly after the menopause it is fairly common in women less than 45 years of age, having occurred in 10.51 per cent of the cases in the series reported.

2 Metrorrhagia was the most common symptom and was the first symptom noted by 63.66 per cent of the patients in this series.

3 Uterine myoma occurs more than three times as often in women with carcinoma of the fundus of the uterus as in women without carcinoma of the fundus of the uterus. The symptoms may be attributed to the myoma and may cause a delay in the making of a diagnosis of malignancy.

4 Every patient having metrorrhagia or an abnormal vaginal discharge should be examined thoroughly to determine the cause of symptoms irrespective of age, and if the symptoms warrant it and the patient is not a poor surgical risk, hysterectomy should be done even if malignancy is not found by curettement.

5 The greatest number of the patients who died following operation for carcinoma of the fundus died during the first 3 years of local recurrence.

6 More five year arrested cases result from operation for carcinoma of the fundus of the uterus than from operation for carcinoma in other commonly affected organs.



## THE INFLUENCE OF TREATMENT WITH HYPERTONIC SODIUM CHLORIDE SOLUTIONS IN PATIENTS WITH ACUTE ABDOMINAL LESIONS

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**I**N a recent paper we have reported a series of 52 cases suffering largely from acute abdominal conditions in which the chloride in the blood was low. We compared a series of untreated or inadequately treated cases with a series in which an attempt was made by treatment with intravenous injections of hypertonic sodium chloride to restore the blood chlorides to normal. The untreated series was divided into two groups: those with the chlorides above 260 milligrams<sup>1</sup> and those with the chlorides below 260 milligrams. In the latter group of patients who were untreated by hypertonic salt solution the mortality was three times that of the group with the blood chlorides above 260 milligrams. Apparently the patients with the milder degree of toxemia were able to control it spontaneously without any other therapeutic assistance. We also reported a number of cases with chlorides below 260 milligrams treated with intravenous injections of hypertonic sodium chloride and glucose with very favorable results and discussed the rationale of this form of therapy. At this time we did not have enough patients to compare statistically the mortality of the treated and the untreated cases. Now we wish to publish a larger series with low blood chlorides which will give us ample material to compare statistically the reduction in mortality under treatment. From the list of treated cases in the preceding paper we have taken 8 in which abdominal lesions were present together with a chloride of less than 260 milligrams and in which the patients received adequate treatment by the methods previously described. To these we have added 22 further cases with chlorides below 260 milligrams which were properly treated. During the period of this study, the operating surgical personnel of the

hospital and the surgical resident were unchanged, and the only alteration made in the treatment of this group of patients was the introduction of the frequent intravenous use of hypertonic solutions of sodium chloride and glucose.

The results of this form of therapy are shown in Table I. When all the cases in the series are considered, it is apparent that in the untreated cases the mortality rose from 25 to 50 per cent as the chloride content of the blood fell below 260 milligrams, while the mortality in the treated cases in which the chloride content was below 260 milligrams was reduced from 50 to 30 per cent as compared with the untreated cases. We did not feel that this statement of the situation told the whole story, however, since a number of patients died of such conditions as broncho-pneumonia or cardiac failure. Although these were undoubtedly precipitated by the low general resistance of the patient, they were not directly concerned with the abdominal lesion. In addition, a number of general medical cases, such as encephalitis, bichloride poisoning, and so on, were included both in the patients living and the patients dead.

This leaves us a group of 77 patients, and this corrected mortality (Table I) shows still more strikingly the improvement brought about by the use of hypertonic sodium chloride solution. In the untreated cases with chlorides above 260 milligrams there is only a 10 per cent mortality which rises five fold to 50 per cent as the chloride content of the blood falls below 260 milligrams. But proper treatment of this toxic group of patients reduced the mortality from 52 per cent to 22 per cent, or more than half. In other words, out of every 100 deaths under the old methods of treatment about 60 cannot be prevented.

<sup>1</sup>Chlorides do not on filtrate of whole blood by Whiteborn method and calculated as chloride (normal limits between 400 and 500 milligram).

TABLE I—MORTALITY IN CONDITIONS WITH LOW BLOOD CHLORIDES

	Total cases	Deaths	Mortality per cent
Untreated above 260 mgm			
Uncorrected	28	7	25
Corrected	21	2	10
Untreated below 260 mgm			
Uncorrected	32	16	50
Corrected	23	12	52
Treated below 260 mgm			
Uncorrected	30	9	30
Corrected	27	6	22
Total cases uncorrected 90			
Total cases corrected 71			

We have been a little uncertain just what procedure to advise in treating patients who are usually considered as surgical emergencies, that is, whether it is best to operate immediately and treat the toxæmia after ward, or whether it is preferable to defer operation for a few hours and thus attempt, at least, in part to control the symptoms. We are gradually accumulating material on this point, but we do not feel that as yet we have sufficient data for a final decision. In the case of patients with ruptured appendix and general peritonitis, we have noted a tendency among the surgeons in charge to delay operation for a few hours for medical management, if a definite diagnosis of rupture has been made. Our experience with cases of acute intestinal obstruction is that the mortality of these cases is arranged according to the number of hours of pre operative medical treatment. The greatest percentage of recoveries occurs in the patients who are not operated upon immediately but who are given a few hours of preparation.

As a rule, the fall in chlorides roughly parallels the severity of the toxæmia. This is not always the case and the patient may occasionally show little toxæmia clinically with a low chloride. One of the cases reported is a marked example of this. After operation for the relief of intestinal obstruction the patient continued to show a marked alkalosis although her clinical condition was extremely satisfactory and she was therefore given no further intravenous treatment. We have noted a tendency in this group toward a very rapid clinical change for the worse and if treatment is not instituted, observation of the condition of the patient should be very close

TABLE II—COMPARISON OF CARBON DIOXIDE CAPACITY AND CHLORIDE IN BLOOD

The areas enclosed within the rules represent the normal values. The numbers represent the number of cases falling into the range of each square. This table shows that as the chloride falls there may be no change in acid base equilibrium as in acidosis or an alkalosis. There are nearly as many cases of mild acidosis as there are of alkalosis.

Blood chloride mgm	CO <sub>2</sub> CAPACITY (vol %)										Total number of cases
	10-20	21-30	31-40	41-50	51-60	61-70	71-80	81-90	91-100		
310-304						2	3	1			4
300-291							3				5
290-281							1				3
280-271			2	1	2	4	2		1		12
270-261					6	5	5	2			18
260-251				3	3	10		1			17
250-241			1	3	3	3	5		2		14
240-231				1	3	3	2	3	1		13
230-221				2	3	3					8
220-211						3					3
210-200					1			1	1		3
Total		3	10	22	38	75	7	5		100	

and frequent. Of course, such an attitude will result in the giving of intravenous medication occasionally to those who might not be in need of it, but it should in general tend to lower the mortality.

We find since our first paper that we are abandoning almost entirely the 1 and 2 per cent sodium chloride solutions and are practically always using solutions of 5 and 10 per cent sodium chloride in 10 per cent glucose. In all of our series of intravenous injections we have had only one reaction and this was not severe. Our only precautions are to insist that the water used in making solutions must be freshly distilled and that no solution should be kept longer than 3 days. We do not insist on triply distilled water as do some surgeons.

We have now accumulated sufficient chemical data to have some idea as to the interrelationships between the non protein nitrogen chloride, and carbon dioxide capacity in this type of case. This material is partially presented in Table II. We have studied the relationship between the blood chlorides and the non protein nitrogen in 165 cases and have found that as the chlorides fall the non protein nitrogen may remain normal or be elevated. Thus the chloride is a more delicate indicator of the presence of the toxæmia than the non protein nitrogen which represents more nearly an end stage

A study of Table II shows the relation existing between the blood chlorides and the carbon dioxide capacity in 100 cases. It will be seen that as the chloride falls the acid base equilibrium may be undisturbed or that either an alkalosis or an acidosis may exist. In fact, almost as many cases show a moderate acidosis as show an alkalosis. This is somewhat contrary to the impression gained by reading the literature that has appeared on the subject, which emphasizes the factor of alkalosis.

We have also noted that practically all the cases of alkalosis occur with non protein nitrogen that is normal or nearly normal and that nearly all the cases of acidosis occur as the non protein nitrogen rises.

An analysis of the literature on the chemical aspects of this question suggests the following explanation of these events. Many other factors than those discussed are certainly operative, however. The primary fate of the blood chloride is unknown. Vomiting due to the loss of hydrochloric acid certainly accentuates its fall. It has been claimed that even if vomiting does not occur there is sufficient gastric dilatation with residual gastric contents to account for the chloride loss. In one of the cases of our series, there was a low chloride content with alkalosis without vomiting in which aspiration shortly after the blood test showed no residuum. We have seen a similar condition in a uræmic patient with extremely low chlorides in the blood. Whatever may be the cause, the disappearance of chloride leads to an excess of free base in the blood. This is apparently compensated for by a retention of carbon dioxide as carbonate. Thus, instead of sodium and potassium chloride in the blood, we have a substitution of sodium and potassium carbonate. This again is not the only factor causing a rise in carbon dioxide capacity, since analysis of the blood shows that there is not a milliequivalent replacement of the chloride ion by carbonate ion. In uræmia with nitrogen retention there is a tendency to acidosis, due mainly to a retention of acid radicles such as sulphate and phosphate by the kidney. Apparently, similar factors are present here since as the non protein nitrogen in the blood

rises the carbon dioxide capacity falls from the level of alkalosis to normal or even below normal with the production of acidosis. It would seem, then, that the fall in chloride is the primary feature and thus in some manner tends to cause a rise in carbonate and a rise in non protein nitrogen, but as the non protein nitrogen rises, conditions are changed so that there is a tendency to lower the bicarbonate of the blood. The actual amount of bicarbonate present at any given moment, therefore, will be the resultant of these two opposing groups of factors.

Much chemical work of this type was essential in working out this series of cases. It remains to be seen if this cannot be considerably simplified, so that the principles described above can be more easily applied in the treatment of patients in institutions where so much laboratory work is not easily available. As we have shown, the chloride is the most delicate of the 3 tests, and for this reason alone should be given preference to the others. So far as the treatment of the patient is concerned, the determination of the non protein nitrogen is of little importance, since it is only an indication for forcing fluids and giving an adequate amount of glucose steps which should have been taken in any event. Hence, this test can be omitted with little loss. The treatment with chloride alone is sufficient to relieve an alkalosis in most cases. If an acidosis is present, it is nearly always mild and disappears when the non protein nitrogen returns to normal under treatment. Hence, the determination of the chloride alone will be sufficiently accurate for outlining treatment. The method of Whitehorn is simple and can be done in any laboratory which is equipped to do blood sugar tests. In fact it is done with the same Folin Wu protein free filtrate. The volumetric standards can be purchased by the small hospital laboratory instead of being made there, if necessary. In the case of patients not in the hospital, or where no facilities are available for blood chemistry, even the chloride determination can be dispensed with. Our series of cases clearly shows that patients with abdominal lesions showing the clinical signs of toxæmia de-

scribed in our preceding paper almost invariably show a low chloride content in the blood. In case of doubt, then, it is perfectly safe to give such intravenous injections when the toxæmia is clinically present. It will do no harm and may place the patient on the road to recovery. Since, from the emergency standpoint, the administration of salt is more important than the administration of glucose, in an urgent case the physician could boil up from 5 to 10 tablespoonfuls of table salt in a quart of distilled water, or even tap water, on the kitchen stove, give it intravenously, and be almost as scientific as his more favored professional brother with adequate hospital facilities.

We wish to emphasize again that all of these cases have been accumulated in less than 18 months in a hospital of less than 300 beds. We feel, therefore, that this syndrome is much more common than is generally supposed and is being overlooked in many places. Since proper therapy in this group of patients results in such a marked reduction in surgical mortality, it is advisable for every physician to be on the lookout for the manifestations of this syndrome in his own patients.

#### SUMMARY

1 A series of 90 patients with low blood chlorides, associated in most cases with acute abdominal lesions, is reported. The treatment of these patients with hypertonic salt solution intravenously has reduced the operative mortality more than one half.

2 In acute cases, such as ruptured appendix with general peritonitis and acute intestinal obstruction, there is accumulating evidence to show that the mortality is reduced by giving the patient a course of pre operative medical treatment rather than operating immediately.

3 The fall in blood chloride usually parallels the severity of the toxæmia but this is not always the case, since some patients may have a considerable fall without much clinical evidence of toxæmia.

4 A comparison of the chemical tests in this group for chloride, non protein nitrogen, and carbon dioxide capacity has been made. The chloride is the most delicate indication

of the toxæmia and may or may not be accompanied by a rise in non protein nitrogen. The carbon dioxide capacity tends to rise until the rise in non protein nitrogen occurs, when it begins to fall, often resulting in an acidosis rather than an alkalosis.

5 For practical therapeutic purposes, the laboratory work can be abridged so that only the blood chloride estimation is used, or intravenous medication may safely be given in the presence of clinical signs of the toxæmia without resort to the laboratory at all.

6 This large series of cases was collected from a small hospital in a short period of time, hence, we feel that this syndrome is being generally overlooked.

#### SUMMARY OF LIVING TREATED CASES WITH BLOOD CHLORIDE BELOW TWO HUNDRED SIXTY MILLIGRAMS

CASE 1 Male, white, aged 45 years admitted to hospital September 19, 1927. Diagnosis perforated duodenal ulcer with general peritonitis, of 24 hours duration. Immediate operation consisting of closure of perforation and drainage was done. Postoperative treatment lavage, enemas and intravenous injections of 500 cubic centimeters of 10 per cent sodium chloride and 10 per cent glucose were given daily for 3 days.

#### BLOOD CHEMISTRY

	Cl mgm	CO <sub>2</sub> vols %	NPN mgm
9-19	210	56	29
9-20	260	56	35
9-21	300		35

CASE 2 Male colored aged 26 years was admitted to the hospital September 17, 1927. Diagnosis perforated duodenal ulcer with peritonitis, of 36 hours duration. Pre operative treatment intravenous injection of 500 cubic centimeters of 5 per cent sodium chloride and 10 per cent glucose. Operation a few hours later closure of perforation and drainage. Postoperative care intravenous injection of 500 cubic centimeters of 5 per cent sodium chloride and 10 per cent glucose for 3 days.

#### BLOOD CHEMISTRY

	Cl mgm	CO <sub>2</sub> vols %	NPN mgm
9-17	245		32
9-19	290	58	41
9-20	290	60	32
9-21	300		36
9-22	280		31
9-23	265		35

CASE 3 Female white aged 26 years was admitted to the hospital May 6, 1927. Diagnosis carcinoma of the ovary with general carcinomatosis.

Exploratory laparotomy was done and the abdomen closed without drainage. Following operation patient began to suffer with distention, nausea, and vomiting. Postoperative treatment consisted in lavage, enemas, and the intravenous injection of 450 cubic centimeters of 2 per cent sodium chloride and 10 per cent glucose daily for 3 days.

## BLOOD CHEMISTRY

	CL mgm	CO <sub>2</sub> vol. %	NPN mgm
5-9	250	80	56
5-13	260	68	41
5-17	270	73	36

CASE 4 Male white, aged 62 years was admitted to the hospital September 28 1927. Diagnosis duodenal ulcer. Operation posterior gastroenterostomy. Ten days after operation patient began to vomit large amounts of greenish material. Stomach lavage was begun and intravenous injections of 500 cubic centimeters of 5 per cent sodium chloride and 10 per cent glucose were given daily for 3 days. Second operation release of adhesions which were causing obstruction of the distal loop. A Murphy button was inserted between distal and proximal loops. Injections of 500 cubic centimeters of solutions were given daily for 4 days.

## BLOOD CHEMISTRY

	CL mgm	CO <sub>2</sub> ols. %	NPN mgm
10-12	240		35
10-13	240	69	42
10-14	265		38
10-15	300		24

CASE 5 Male, white, aged 32 years was admitted to hospital June 30, 1927. Diagnosis intestinal obstruction due to postoperative adhesions. Pre-operative care lavage enemas and intravenous injections of 500 cubic centimeters of 5 per cent sodium chloride and 10 per cent glucose. Operation to relieve the obstructions was done a few hours later. Intravenous medication was continued daily for 4 days.

## BLOOD CHEMISTRY

	CL mgm	CO <sub>2</sub> vol. %	NPN mgm
7-1	255	70	39
7-2	290		
7-3	290		
7-4	280		
7-5	325		34

CASE 6 Male white aged 58 years, was admitted to hospital October 28 1927. Diagnosis intestinal obstruction postoperative adhesions. Pre-operative care consisted in lavage enemas and two injections intravenously of 500 cubic centimeters each of 10 per cent sodium chloride and 10 per cent glucose solutions. At operation the obstruction was released. The patient was given daily injections of 500 cubic centimeters of the solution named.

## BLOOD CHEMISTRY

	CL mgm	CO <sub>2</sub> vol. %	NPN mgm
10-28	210	88	67
11-10	280	68	21

CASE 7 Male, white, aged 8 years, was admitted to hospital June 21 1927. Diagnosis ruptured appendix with general peritonitis. He was operated upon at once. Twenty four hours after operation the patient became distended vomited large amounts, and was very toxic. Treatment consisted of lavage and enemas and intravenous medication was started. 400 cubic centimeters of 5 per cent sodium chloride and 10 per cent glucose being given daily for 3 days.

## BLOOD CHEMISTRY

	CL mgm	CO <sub>2</sub> vol. %	NPN mgm
Day of vomiting	215		50
After treatment 300	300		24

CASE 8 Male, white, aged 61 years was admitted to hospital October 20 1927. Diagnosis strangulated femoral hernia of 17 hours duration. Pre-operative treatment consisted in lavage enemas and two intravenous injections of 500 cubic centimeters of 5 per cent sodium chloride and 10 per cent glucose solution. Operation reduction of hernia. Patient developed an ileus after operation. He was given intravenous injections of the solutions named 500 cubic centimeters twice a day for 3 days.

## BLOOD CHEMISTRY

	CL mgm	CO <sub>2</sub> vol. %	NPN mgm
10-20	250		60
10-21	270	64	49
10-22	250	58	41

The cases mentioned are selected from a large series and show the changes in the blood chemistry produced by toxæmias of intestinal origin and how such toxæmias can be controlled by intravenous medication of glucose and sodium chloride. The best results obtained in dealing with such cases depend largely upon (1) repeated stomach lavage (2) enemas (3) the patient being allowed nothing by mouth, and (4) the intravenous injection of sodium chloride and glucose, the strength of the solutions depending largely upon the severity of the toxæmia, for most cases 5 per cent sodium chloride and 10 per cent glucose in 500 cubic centimeter quantities, repeated as often as necessary.

## SUMMARY OF THREE FATAL TREATED CASES

WITH BLOOD CHLORIDE BELOW TWO HUNDRED SIXTY MILLIGRAMS

CASE 1 Male white, aged 32 years was admitted to the hospital April 15 1927. Diagnosis gunshot wound of abdomen with perforation of small intestine and bladder. Immediate operation was done consisting in resection of portion of small intestine closure of bladder, and abdominal drainage. Patient

developed an ileus and peritonitis, the abdomen became distended, and he vomited. Lavage and enemas were given and intravenous medication was started. Five hundred cubic centimeters of 10 per cent sodium chloride and 10 per cent glucose were given twice a day for 4 days. Patient died of peritonitis.

## BLOOD CHEMISTRY

	Cl mgm	CO <sub>2</sub> vols %	NPN mgm
4-18	225	70	43
3 to 8 days later	230	59	31

CASE 2 Male, white, aged 28 years, was admitted September 7, 1927. Diagnosis ruptured appendix with general peritonitis. Immediate operation consisted in appendectomy and drainage. Injections of 500 cubic centimeters of 5 per cent sodium chloride and 10 per cent glucose were given intravenously daily for 3 days. Two days after operation patient showed signs of obstruction and an enterostomy was done. Intravenous medication was continued but the patient died 2 days later.

## BLOOD CHEMISTRY

	Cl mgm	CO <sub>2</sub> vols %	NPN mgm
9-7	225	56	31
9-9 (obstruction)	230	40	32
9-10 (day of death)	280	60	50

CASE 3 Female white, aged 58 years, was admitted to hospital May 31, 1927. Diagnosis intestinal obstruction due to a large gall stone. She

was given the usual pre-operative treatment: lavage, enemas and one injection of 5 per cent sodium chloride and 10 per cent glucose, 500 cubic centimeters. Operation: removal of gall stone from intestine. Intravenous medication was continued for 3 days—500 cubic centimeters of solutions named, twice daily. Patient developed a marked ileus and enterostomy was done under local anesthesia. She died a few hours after operation.

## BLOOD CHEMISTRY

	Cl mgm	CO <sub>2</sub> vol %	NPN mgm
5-31	280		52
Day of death	300		51

We have other cases that could be reported in this group which would show that at the time of death, the toxæmia was under control by intravenous medication of glucose and sodium chloride, as shown by the blood chemistry, and that death was produced by other contributory factors. The few cases reported are selected from a large series.

## REFERENCE

- ROCKWOOD, R. and ANDERSON, R. S. Changes in the chloride metabolism in abdominal lesions. Surg Gynec & Obst. 1928 xlv: 352-360.

## THE HEART IN SURGERY

AN ANALYSIS OF THE RESULTS OF SURGERY ON CARDIAC PATIENTS DURING THE PAST TEN YEARS  
AT THE MASSACHUSETTS GENERAL HOSPITAL<sup>1</sup>

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THERE is, no doubt, a persistent difference of opinion between the surgeon and the internist about the importance of the heart in surgery. The reason for this is, I believe, simple but in need of honest discussion. It rests upon the following facts. In the first place, cessation of the heart beat is the condition most easily discovered at the moment of death. It is assumed, therefore, that something is wrong with the heart whenever death occurs. Yet, in an experimental animal, the heart, after its beating has been inhibited by toxic substances introduced into the circulation, can be isolated and made to beat again for hours with a proper perfusate. Second, the surgeon is apt to emphasize heart weakness and failure as an explanation of operative mortality, when the real cause may be surgical shock, hemorrhage, sepsis, pneumonia, peritonitis, or the result of anesthesia. Lastly, the internist makes dogmatic statements about the condition of the heart and tends to forget that the mechanisms involved in the failure and death of certain types of diseased hearts in man—notably the heart in hypertension—are totally unknown.

The situation, therefore, is that the internist believes he can diagnose heart disease in life but can state only in a general way the patient's chances under operation, while the surgeon may deny his ability to discover heart disease while the patient is alive but often confidently makes such a diagnosis if the patient dies.

It is not my intention to discuss the whole subject of the heart in surgery, for I feel that it has been well done in recent years. The conclusions of those who have considered this question are mainly these:

1. The heart cannot be considered apart from the vasomotor system.

2. The ability of the patient to carry on his daily activities without symptoms usually tells more about his myocardial power than

can be discovered on examination of his heart.

3. No type of heart disease is, *per se*, a contra-indication to necessary surgery.

4. Congestive heart failure greatly increases the danger of complications and the mortality from surgery.

5. Medical treatment of a failing heart before operation in some cases may convert a poor surgical risk into a relatively good one.

6. Obese and chronically septic cases are poor risks for surgery.

7. The behavior of the respiration, pulse, and blood pressure during and after operation is the best clinical guide to both internist and surgeon.

8. Other things being equal, the skill of the anesthetist and the surgeon is often the determining factor in assessing to the cardiac the risk of surgical procedures.

I am presenting here an analysis of the fate of proved cardiacs who have undergone surgery in this hospital in the 10 years prior to January 1, 1928. The data were obtained from a study of the records of all patients who, during this period, were discharged from surgical services with a diagnosis of heart disease. For the figures of the past 4 years I have also studied the reports of deaths on surgical services reported at the staff meetings. A fair number have probably eluded the search for various reasons, such as the fact that milder grades of heart disease are recognized more readily on medical than on surgical services. However, most of those with frank heart disease are undoubtedly included.

Of 284 such cardiac patients, 170 were selected for study. All but 21 of these patients were seen by medical consultants, 38 were seen by the cardiac service. Sixty-eight others were discharged without operation because of a change in diagnosis, a mistaken admission to a surgical service, refusal of operation, and rarely because of the cardiac

<sup>1</sup>Read before the Clinical Congress of the American College of Surgeons, Massachusetts General Hospital, Boston, October 8, 1928.

status or other medical contra indication. Forty six were discarded because of insufficient evidence of heart disease, except such conditions as terminal pericarditis in septic cases or transient arrhythmias.

The postoperative course of these 170 cases (84 males and 86 females) has been reviewed to discover, if possible, what types of cardiac disease influence prognosis. They have been studied under etiological classifications and functional diagnoses in the cases of auricular fibrillation, heart block and angina pectoris.

One hundred and ninety two operations were performed on the total group of 170 patients. The anæsthetic was ether in 86 cases, local novocain in 44 cases, nitrous oxide and oxygen in 21, ethylene gas in 17, spinal novocain in 8, sacral novocain in 5, and different combinations in 11 cases. I can find no significant correlation between the type of anæsthesia and mortality in this series or between the mortality and the pre-operative blood pressure. It is worth noting that no patient died during or following operation from cerebral hæmorrhage although 19 had a systolic blood pressure of over 200 millimeters Hg.

In any consideration of death from heart disease, one must start with the statement that demonstrable heart failure takes only two main forms: congestive, with dyspnoea, orthopnoea, cyanosis, hepatic and pulmonary engorgement, and œdema, or anginal with substernal oppression or other manifestation of angina pectoris, or by the allied conditions of pulmonary œdema or cardiac asthma. In general, a pronounced fall in blood pressure, pallor, cold sweat and tachycardia (in the absence of coronary occlusion) is more apt to be a vasomotor disturbance or an evidence of shock or hæmorrhage. Rarely the onset of such arrhythmias as auricular fibrillation, auricular flutter, or paroxysmal tachycardia in an already weakened heart may give this picture. It is the picture of a heart with too little rather than too much blood to pump, but has often been incorrectly ascribed to "acute dilatation of the heart."

#### SUDDEN DEATH DURING OPERATION

Of the 170 patients in this series 42 died during or following operation (24 males and

18 females), a gross mortality of 24.7 per cent, but only 5 patients died suddenly on the operating table. One of these was a man of 52 operated on by mistake for perforated viscus in the throes of what must have been a coronary thrombosis, 1, a man of 37 with syphilitic aortitis and angina pectoris, undergoing a cervical sympathectomy, 1, an obese colored woman of 42 with a fibroid uterus of football size adherent to the sigmoid, cardiac enlargement, and acute myocardial degeneration and pulmonary œdema at autopsy, another was a negress of 23 with chronic rheumatic disease of mitral and aortic valves and adherent pericardium who died during the induction of ether anæsthesia before tonsillectomy was begun, and the last was a woman of 54 with hypertension and marked obstructive jaundice from carcinoma of the pancreas who died following a marked slowing of the heart rate during an ethylene anæsthesia for cholecystgastrostomy.

The relative infrequency of death from heart disease during operation is further emphasized by a survey of 20 other cases of unexpected death under anæsthesia occurring in this hospital in the past 5 years. In but one of these cases (a child of 5 years of age) was there known heart disease present. No adequate cause for death was found in 10 cases that came to autopsy. Six operations were tonsillectomies on 4 children under 5 years of age, 1 girl of 19, and 1 woman of 35. Fifteen patients were 40 years of age or younger and the oldest was a man of 60 undergoing resection of the second and third trigeminal nerve roots for carcinoma of the tonsillar fossa. Fourteen were having ether, and 1 each cocaine plus novocain, novocain alone, nitrous oxide gas and oxygen, nitrous oxide gas, oxygen and anæsthol, spinal novocain and ethylene, and local novocain plus ethylene. Unexpected death on the operating table is, in our experience, more common in young people without heart disease than in old people with it.

#### CAUSE OF POSTOPERATIVE DEATHS

When we analyze further the deaths following operation we discover that of the 42 who died, only 22 (or a little less than 53 per cent of the total series) died from causes directly



referable to the heart. We must, of course, admit that cardiac disease may well have made some of the others more susceptible to pathological conditions from which they died, such as thrombosis pulmonary embolism, and pneumonia. Of the cardiac deaths, 8 were congestive in type, 5 from possible or proved coronary occlusion, 3 inginal, 2 from the complication of a paroxysmal abnormal cardiac rhythm in weakened patients, and 1 each died from complete heart block, acute endocarditis cryptic aortitis, and pulmonary oedema. Twenty died from extracardiac causes—6 from bronchopneumonia, 8 from sepsis, 2 from anaesthesia, 1 each from fractured skull, metastatic carcinoma and pelvic vein thrombosis postoperative vomiting and haematemesis, and chronic tuberculous mediastino pericarditis. Only 13 of the 42 who died were under 50 years of age and 8 were over 70. The duration of life after operation was from a few minutes to 62 days. Four died on the day of operation, 12 in the first 3 days, 20 in the first week. Seventeen lived more than one week and 9 more than 3 weeks. Not quite one half of the cardiacs in our series who died lived more than a week after the operation.

#### RHEUMATIC HEART DISEASE

Forty-seven patients with rheumatic valvulitis and normal cardiac rhythm were operated on. Only 4 died, 1 following a laparotomy for gall bladder disease which revealed only a congested liver, due, as autopsy showed to acute endocarditis, 1 with bronchopneumonia and sepsis after curettage for incomplete abortion requiring three transfusions, 1 from general peritonitis following appendectomy for ruptured appendix, and 1 from anaesthesia prior to operation. Heart disease was probably not responsible for the death of any but the case of acute endocarditis. Congestive heart failure was however present in only 2 patients in this group before operation, neither of whom died. Members of this group survived appendectomy in 10 cases, laparotomy for other causes in 7, and thyroidectomy in 5.

Nine patients had auricular fibrillation as a result of rheumatic heart disease, of these 7 died. One was a woman of 45 who had a mid

thigh amputation because of embolic gangrene of her leg and died 50 days later of probable mesenteric thrombosis, and the other was a man of 48 who died 19 days after colostomy for carcinoma of the rectum with extensive metastases.

#### ARTERIOSCLEROTIC AND HYPERTENSIVE HEART DISEASE

It is in the group of degenerative heart disease, arteriosclerosis with or without hypertension, that the greatest mortality is found. This group is the one concerning the operability of which the internist and surgeon are most uncertain. Seventy-five such patients were included in this study and 24 died, one half of them succumbing to heart failure. One of these was a man of 82 years, with aortic stenosis. However, another man of 52 years who had had a coronary thrombosis survived a two stage operation for carcinoma of the rectum. Of the 24 with auricular fibrillation, 9, or 37.5 per cent died, of those surviving 2 had prostatectomy, 2 repair of hernia and 1 each cholecystectomy, hysterectomy, colostomy, excision of thyroid adenoma, cervical repair and embolectomy and amputation of a leg.

Six cases of relatively pure hypertensive heart disease were submitted to operation. They were all women. Cholecystostomy, cholecystectomy, cholecystgastrostomy, hysterectomy, nephrectomy and dilatation of anal fissure were the operations. Ether was given in 5 cases combined once each with anaesthol and with spinal novocain, and ethylene once. Three patients died, 1 from the anaesthetic, 1 from pulmonary oedema, and 1 with postoperative vomiting and haematemesis.

#### MISCELLANEOUS ETIOLOGICAL FACTORS

I have collected only a small group of thyroid heart disease. Of 14 such cardiacs with auricular fibrillation only 1 died, a woman of 62 with a thyroid adenoma requiring hemithyroidectomy who had also arteriosclerosis, hypertension and congestive heart failure. Two patients with normal heart rhythm survived operation although 1, a girl of 12, died at home from exophthalmic goiter.

3 months after ligation of the right thyroid artery

Of 6 with syphilitic heart disease, exclusive of those with angina pectoris 2 died 1 suddenly with unsuspected aortitis during hysterectomy (the patient was not seen by the medical service) and the other with chronic sepsis and pneumonia following cholecystectomy for a necrotic gall bladder. The aortitis was not diagnosed in this case either although the Wassermann was strongly positive. The other 4 cases had aortic regurgitation and all survived. One wonders if the presence of the diastolic murmur led to more care in anaesthesia. Ether was given to those who died, and local novocain, nitrous oxide gas and oxygen, spinal novocain plus ether, and ether alone to the others. The latter operations were, however, less severe amputation of the penis, thyroidectomy, suprapubic prostatectomy, and ureterotomy. Of the 4 cases with syphilitic aortitis and angina pectoris, 2 died suddenly following cervical sympathectomy.

Two patients had Pick's syndrome with chronic ascites, one had a Talma operation and the other thoracotomy for empyema. Both died.

One baby with congenital heart disease was successfully operated on for hare lip. A boy of 16 with congenital pulmonic stenosis, cyanosis and clubbed fingers had an uneventful recovery from an appendectomy for chronic appendicitis.

*Angina pectoris.* Thirteen cases of angina pectoris underwent surgery, 7 of them for cervical sympathectomy. Of the 7, 3 died following operation—1 on the table, one 3 hours after operation and 1 on the day after his third operation. The only other death in the group with angina was the case of coronary thrombosis unfortunately submitted to laparotomy. Three other laparotomies and one thoracotomy were uneventfully survived.

*Paroxysmal abnormal heart rhythms.* Two cases of paroxysmal ectopic heart rhythm are worth special mention. Both patients died and their fate seemed definitely related to the onset of abnormal cardiac rhythms which are usually benign—paroxysmal auricular fibrillation and paroxysmal tachycardia.

An extremely obese woman of 46 with a preoperative blood pressure of 95 systolic and 60 diastolic was operated on for fibroids. A myomectomy for pedunculated fibroid was being done but after 50 minutes of ether anaesthesia the heart suddenly developed auricular fibrillation said to have been first at a ventricular rate of 250 and later at 150. The blood pressure remained very low and she died 6 hours later. More apprehension was felt by the surgeons during this attack, and rightly (as was justified by the subsequent fatality), than by the medical consultant. The surgical fear was based on the persistently low blood pressure and the medical optimism upon the fact that postoperative paroxysmal fibrillation is usually temporary and relatively benign. The autopsy report showed an unusually obese woman whose muscles were pale pink and very flabby. The mesentery was laden with a great amount of fat and the large intestine was completely invested with a thick, fatty covering. The heart weighed 415 grams, an unusually heavy deposit of fat being present in the epicardium especially over the right ventricle. The heart was otherwise negative. The liver weighed 2085 grams and was flabby and a pale yellow pasty brown. In the pancreas the lobules appeared as "whitish islands in a sea of fat." The heart was negative microscopically except for a few small areas of fibrosis.

It is possible that this case shows in a marked degree the elements which make obese patients poor surgical risks. The factors seem to be the weak musculature in general, the mechanical oppression of fatty masses, the replacement by fat of the tissues of vital organs, the respiratory and circulatory disturbances (in this case due to the Trendelenburg position), the supersaturation of the body by ether from its affinity for lipoids and the possible endocrine dysfunction as evidenced by the obesity and hypotension. The onset of the abnormal cardiac rhythm probably only functional in origin in this instance, further lowered the blood pressure and led together with a state of shock, to death.

The second case was a man of 40 without a preoperative diagnosis of heart disease. His blood pressure was 140 systolic and 70 diastolic. Three days after a first stage operation for carcinoma of the rectum, he suddenly developed a tachycardia of 180 lasting only a few hours. The resident on the cardiac service saw the patient and made a diagnosis of paroxysmal tachycardia and advised 3 grains of quinidine sulphate three times a day. No electrocardiogram was taken. The patient was progressing well until 4 days later when another attack started.

at a rate of 220. He became restless and dyspnoeic and 3 hours later died suddenly with marked shortness of breath. No autopsy was performed and because of the absence of graphic records one can only speculate on the mechanism of the attack. It may have been paroxysmal tachycardia of auricular or ventricular origin or auricular flutter. The blood pressure during the attack was not recorded.

Both of these cases illustrate the possibility of confusion in prognosis which may arise when ectopic tachycardia suddenly appears in patients who are operated on. Generally such disorders are "functional" in nature, a term which signifies that we are unable to trace the cause to its origin in microscopic pathology. The heart is normal to our clinical and laboratory tests, except for an increased irritability. But just as paroxysmal tachycardia may be dangerous to patients with mitral stenosis, whose hearts are competent at slow rates, so may extremely rapid heart action be serious in rare cases in which there may be present some pathology which escapes our clinical diagnosis. Its effect may be through a decrease in coronary flow. Experiences such as these should warn the cardiologist against a routinely sanguine prognosis in postoperative paroxysmal tachycardias.

In closing I may say that the analysis of these figures of our experience emphasizes certain points:

1 Age is the most important factor in mortality. Two thirds of the deaths occurred in patients over the age of 50. In the 14 dying under the age of 50, syphilitic heart disease was present in 3, rheumatic heart disease in 6 (2 with auricular fibrillation and 4 with normal rhythm), Pick's disease in 2 and hypertension, obesity plus hypotension and unknown heart disease in 1 each. Such a preponderance of age in mortality is to be expected. Miller<sup>1</sup> recently found in a series of 1,000 surgical anesthetics "in the cases where complicating organic disease was discovered at the preliminary examination the mortality rate in patients over 50 was four teen times as great as in the patients less than 50 years of age."

2 Patients with rheumatic heart disease and normal rhythm without congestive fail

ure can be operated on with little danger.<sup>2</sup>

3 Cardiac patients, excepting those with syphilitic aortitis or advanced coronary disease, are not likely to die suddenly during operation. Patients without heart lesions, either by clinical or pathological standards, are more likely to die unexpectedly as a result of anesthesia than are those with demonstrable heart disease. The cardiac succumbs generally to complications or heart failure during the postoperative period, almost one half of our cases that died lived more than a week after the operation. Of the 42 deaths in our series of 170 cardiacs, only 22 died from heart disease.

4 The presence of auricular fibrillation increased the danger of death from operation in arteriosclerotic cases only from 34 to 37.5 per cent but in a small series of rheumatic heart cases from 8.8 to 22.2 per cent. Thyrocardiacs with auricular fibrillation do better with operation for the thyroid hyperfunction than any other group with this arrhythmia due to the immediately favorable effect of thyroidectomy upon the heart.

5 Our records indicate an improvement over the past 10 years in cardiac diagnosis. They show, however, that better coordination of the medical and surgical viewpoints is possible if the suspected cardiac patient, especially the older one, is studied before operation, instead of when he is *in extremis* from which there may be no relief. Such co-operation will be instructive both to internist and surgeon.

6 In a discussion of this subject 27 years ago before the College of Physicians of Philadelphia Dr Ochsner<sup>3</sup> said "I think it would be unfortunate should surgeons receive the impression that patients suffering from heart disease are especially safe. I believe they are safe because they are considered especially unsafe." From our experience I should be inclined to agree with this statement, and so long as surgeons consider cardiac patients "especially unsafe" I believe that their future in the hands of the surgeon is relatively bright.

<sup>1</sup>It might be mentioned that at the House of the Good Samaritan in Boston tonsillectomy has been performed on 14 children with 10 potential rheumatic carditis without a single death as an early or remote result of the operation.

<sup>2</sup>Ochsner. Discussion of paper by J. M. Finney. *Ann. Surg.* 1910, 51: 25.

<sup>3</sup>Miller, A. H. The influence of age in surgical prognosis. *Ann. Surg. Suppl.* 1910, 22: 122.

# SURGICAL ANATOMY OF THE THYROID GLAND WITH SPECIAL REFERENCE TO THE RELATIONS OF THE RECURRENT LARYNGEAL NERVE<sup>1</sup>

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**T**HIS paper is based on a careful dissection of 200 thyroid glands of cadavers in the department of anatomy at the University of Minnesota. The work was undertaken in an endeavor to establish more accurately, if possible, our knowledge of the normal and abnormal position and relations of the recurrent laryngeal nerve, the better to enable us to avoid injury to that structure, most important in surgery of the thyroid gland.

For the elementary classical description of the thyroid gland, the reader is referred to the standard textbooks of anatomy. The authors will discuss at length only those features which have a distinctly surgical significance or those which from this study seem to differ from the usual description of this organ.

## GENERAL CONSIDERATIONS

The thyroid gland is a bilobed, very vascular organ which is situated in the neck over the front and sides of the upper part of the trachea, extending upward on each side of the larynx (Fig 6). It consists of two ovoid lateral lobes, united near their lower borders by a median transverse portion, the isthmus. In this series of 200 cases, the average width of each lobe was 3.25 centimeters, the average length (vertical) was 4.92 centimeters, and the depth (anteroposterior diameter) 2.88 centimeters. The average lobe extended from the upper portion of the lamina of the thyroid cartilage to a distance of 2 centimeters above the clavicle. One hundred and sixty-four (82 per cent of 200 glands) were grossly normal, 36 (18 per cent) were pathological, and 22 (11 per cent) had pyramidal lobes. A gland was considered pathological, in an anatomical sense, when it contained distinct adenomatous masses, or when it was much larger than the average of the so-called normal glands. The presence of a pyramidal lobe was not con-

sidered pathological. The pyramidal lobes varied in size from a small nipple to a process 5 centimeters in length. There were five glands (2.5 per cent) which were found to extend retrotracheal.

The parathyroid glands were noted in each case and were uniformly found to be two small fleshy bodies, varying in size from a small pea to a gland 1 centimeter in diameter. They were found in close contact with the posterior surface of the middle third of each lobe. Often there was no visible fibrous tissue capsule between the parathyroid and thyroid glands.

The relation of the deep cervical fascia to the thyroid gland was of particular interest in this study because of the fact that the so-called capsule of the thyroid gland is made up of the middle or pretracheal layer of this fascia, and because of the usual statement in discussions on the surgery of the thyroid gland that if one remains within this capsule, many if not all of the dangers of thyroidec-tomy will be avoided. Many pages of every textbook of anatomy are devoted to a detailed and confusing description of the deep cervical fascia of the neck. It is ordinarily described as consisting of three layers: (1) a superficial, (2) a middle or pretracheal, and (3) a deep or prevertebral layer (Fig 1A).

The first or superficial layer extends from the ligamentum nuchæ posteriorly, to the midline of the neck anteriorly, and encloses within it the trapezius and sternomastoid muscles. Superiorly this layer extends to the mandible where it is continuous with the deep fascia over the face. Inferiorly it is attached to the upper border of the clavicle and manubrium sterni. This layer is a fairly distinct anatomical entity and one easily demonstrated.

The second, middle, or pretracheal layer is described as enclosing the thyroid gland and blending posterolaterally with the medial surface of the carotid sheath. Superiorly this

<sup>1</sup>Read before the Minneapolis Surgical Society October 4, 1918.



Fig 1A (left) Cross section of neck at level of isthmus of thyroid gland (From Cunningham's *Anatomy*)

Fig 1B Cross section at same level as Figure 1A showing relations of cervical fascia, recurrent nerve and inferior thyroid artery as authors found them

layer is attached to the cricoid cartilage and the lamina of the thyroid cartilage below the insertion of the sternothyroid muscle. Inferiorly it passes down posterior to the sternum into the middle mediastinum to fuse with the fibrous pericardium. This forms therefore the so called capsule of the thyroid gland which is spoken of so glibly and is considered the wall of safety for surgeons, inside of which no harm can come and outside of which dangers await. In only a few instances in this dissection of 200 glands, were the authors able to demonstrate this fascial layer as being of sufficient strength and consistency to be separated in one distinct sheet from the thyroid gland on the inside and the common carotid artery, the internal jugular vein, the inferior thyroid artery, and surrounding areolar tissue on the outside. We did find that this layer of fascia was uniformly well developed over the lateral surface of the thyroid cartilage, where it held the superior pole of the gland firmly in place (Fig 2). We were also able to demonstrate that in nearly 100 per cent of the cases the major portion of what capsule or fascia was present, did not ensheath the thyroid gland on its posterior and medial surfaces. It was, on the contrary, reflected from the posterolateral border of the gland, posterior to the oesophagus, to fuse with its fellow of the opposite side (Fig 1B). This is in accord with the description of this fascia given by F de Quervain.

The third, posterior, or prevertebral layer of the deep cervical fascia encloses the muscles surrounding the vertebral column and assists in

the formation of the posterior wall of the carotid sheath. This layer has no important relation to the thyroid gland and is mentioned only for completeness of description.

#### VASCULAR SYSTEM

The abundance of the blood supply of the thyroid gland is known to every anatomist and surgeon. The large superior thyroid arteries (Fig 6) arise from the external carotid on a level with the thyroid notch and pass downward in an arch which is convex upward to the upper pole of each lobe. Here each artery divides into two or three main branches which spread out chiefly on the anterior and lateral surfaces of the gland to supply the upper half of the lobe and finally to anastomose with branches from the inferior thyroid artery. In rare instances the superior thyroid artery may arise from the common carotid. This did not occur in a single instance in this series of 400 arteries. An important anatomical fact to be remembered by the surgeon, especially in connection with ligation of the superior thyroid artery, is that this is the only artery in the neck in which the blood flow is toward the heart.

The inferior thyroid arteries (Fig 6) are the chief blood supply to the lower and posterior portions of the thyroid gland. Each arises as one of the 3 terminal divisions of the thyroid axis (truncus thyrocervicalis) which in turn is a short stout trunk arising deep in the neck from the subclavian artery on each side. Each inferior thyroid artery passes at first almost vertically upward from 2 to 4 centimeters lying very deep in the neck posterior to the common carotid artery, internal jugular vein, and vagus nerve. It then turns abruptly on itself to descend about half its length and pass medially to enter the posterolateral border of each lobe at the junction of its middle and lower thirds. Before it reaches the gland each artery divides into four to six smaller branches. It is just after this division and before these branches reach the gland proper that the recurrent laryngeal nerve comes into close relation with this artery. This important relation will be discussed later. In order to reach the gland proper, the branches of the inferior thyroid artery must necessarily perforate the



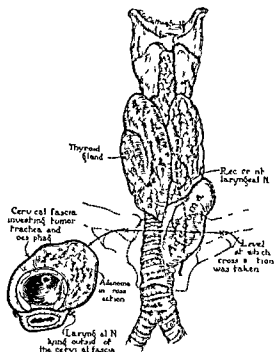


Fig 4A (left) Dissection showing recurrent laryngeal nerve lying posterior to subclavian artery. Nerve has just emerged from under arch of aorta (Not shown in diagram)

Fig 4B Cross section of Figure 4A to show recurrent laryngeal nerve lying just posterior to adenoma separated only by dense layer of deep cervical fascia

interest in this discussion. The cutaneous nerves in this region are branches of the cervical plexus of spinal nerves and are well known and easily demonstrated.

The recurrent or inferior laryngeal nerve (Fig 6) is a branch of the vagus and supplies all of the intrinsic muscles of the larynx except the cricothyroid muscle. The latter is supplied by the external laryngeal branch of the superior laryngeal nerve, also a branch of the vagus. Injury to the recurrent laryngeal nerve is not an uncommon occurrence during thyroidectomy. Statistics as to the frequency of such injury are difficult to obtain and vary from 1 per cent to as high as 14 per cent in some statistics several years old. The effect of trauma on the laryngeal nerves has been the subject of much experimentation and is still a moot question. Judd, New, and Mann in experiments on dogs found that section or

ligation with linen, chromic or plain catgut produced a complete paralysis of the vocal cord of the corresponding side, which in all probability was permanent. They also found that pinching the nerve with a hemostat, such as would occur by a surgeon picking up a small artery, produced a temporary paralysis of the vocal cord. Restoration of function occurred in these cases in from 30 to 60 days. Complete destruction of both nerves caused a total loss of voice, difficulty in swallowing, and dyspnea either continuous or on exertion. These experiments on animals coincide to a large extent with the conditions found clinically in surgery of the thyroid gland.

This would seem to be sufficient reason for a more careful consideration and study of the relations of this most important structure in an endeavor to lessen the frequency of this dreaded complication of thyroidectomy.

As its name implies, the recurrent branch of the vagus arises after the parent trunk has left the neck. The long indirect course of the recurrent laryngeal nerve is brought about by the change of position which the heart and great vessels undergo during embryonic life. At first the mammalian heart lies under the middle of the head, immediately behind the first branchial arches. The fourth pair of branchial arches, by the modification of which the persistent aorta and innominate artery are formed, lies at first no farther back than the occipital region of the skull. The larynx is developed within this same region and the recurrent laryngeal branch of the vagus, with which it is supplied, passes at first directly to its destination, behind the fourth branchial arch. But as development proceeds the heart and great vessels become detached from the branchial arches and move inferiorly until at length they are lodged deep in the thorax while the larynx remains relatively stationary. Hence the recurrent laryngeal nerve becomes drawn out into a long loop, the middle of it pulled back, as it were, by the retrogression of the aortic arch into the thorax. The proof that the course of the recurrent nerves is a question of the development is found in the fact that when, from any cause operating in early life, irregularities of the arch of the aorta or in the origin of its primary branches exist,

the recurrent nerves have always, in such instances, an anomalous origin and course

On the right side the recurrent nerve arises from the vagus just as the latter passes over the arch of the subclavian artery (Fig 6) It hooks around the inferior and posterior surfaces of the subclavian artery and passes upward and medially in the soft tissues along the latter border of the trachea and œsophagus to reach the region of the thyroid gland On the left side the nerve arises lower down in the thorax after the vagus has crossed the anterior surface of the arch of the aorta The recurrent nerve then hooks around the aorta as its fellow of the opposite side does around the subclavian, and ascends into the neck on a deeper and more vertical plane than that of the right side The usual textbook description and cross section of the position of the recurrent laryngeal nerve would lead us to believe that we would find it tucked snugly away in the crevice between the rounding surfaces of the trachea and œsophagus, well behind the capsule of the thyroid gland and therefore out of harm's way (Fig 1A) The authors did not find this happy condition of affairs In the region of the lower pole of the thyroid gland they found that the recurrent nerve lay from 1 to 2 centimeters lateral to the trachea (Fig 6) Here it begins to entwine itself among the branches of the inferior thyroid artery In 262 cases (65.5 per cent of 400) the nerve passed posterior to the main branches of the inferior thyroid artery, in 104 cases (26 per cent) it passed anterior, and in 34 cases (8.5 per cent) it passed between the main branches of the inferior thyroid artery In this region, the nerve gives off minute branches to the œsophagus and trachea after which the main portion of the nerve, much reduced in size, continues on upward and more medially in very close relation to the posterior surface of the middle third of the thyroid gland It then passes between the arch of the cricoid cartilage and the inferior cornu of the thyroid cartilage to enter the larynx and supply its intrinsic muscles The authors were much impressed by the fact that in the large majority of cases the most intimate relation between the gland and the nerve was not at the lower pole as is generally assumed, but rather



Fig 5 Dissection showing left recurrent nerve passing between adenoma and left lobe of gland Note liability of injury of nerve in enucleating such an adenoma

on the posterolateral surface at the junction of the middle and lower thirds, namely at or just above the point where the chief branches of the inferior thyroid artery enter the gland As noted previously the authors did not find the capsule of the thyroid gland to be such a consistently definite structure as it is usually considered, and when it was developed, it was found to be reflected from the posterolateral border of the gland to the posterior surface of the œsophagus (Fig 1B) This being true, it is evident that in order to pass from its origin to its destination, the recurrent laryngeal nerve must perforate the capsule of the gland if such be present (Fig 1B and Fig 2), and in any event come to lie in close apposition to the posterior surface of the thyroid gland inside of the capsule (Fig 1B) The authors found this relation to exist in nearly 100 per cent of their cases, and therefore believe that the old teaching that the recurrent laryngeal nerve is always posterior to the capsule of the thyroid gland is an inaccurate observation and dangerous from the surgical standpoint because of the sense of security thereby imparted to inexperienced operators

Many variations were found in the relation of this nerve, chief among which were the following in 8 cases, the nerve was in a much more anterior plane, i.e. parallel with the anterior half of the trachea, and in two of



these specimens, it bridged over an extra large branch of the inferior thyroid artery in very close relation to the lower pole of the gland (Figs 3A and B). In Case 41 (Figs 4 A and B), the nerve lay directly between the sub-sternal and regular lobe, separated only from the substernal portion by the dense layer of fascia which had been pushed down into the mediastinum ahead of the developing pathological lobe. In Case 47 (Fig 5), the nerve was in direct contact with the posterior surface of a small adenoma. Case 53 (Fig 2) showed clearly the branches of the nerve and artery perforating a well developed capsule. Case 70 (Fig 3 B) showed an unusually large process of the gland extending posterolaterally from the middle third of the right lobe. In this case the nerve passed upward in the crevice between this process and the major portion of the lobe.

The authors also demonstrated that the position of the nerve with relation to the gland was not altered by any displacement or pulling anteriorly of the lobes of the thyroid gland. If such did not take place in fixed formalized specimens, it seems very unlikely that such a condition would obtain in the fresh living pliable tissues dealt with in surgery.

The authors have been unable to find any reference in the literature to injury of the external laryngeal nerve during thyroidectomy. It would seem from this study that such an accident might be very possible and may explain some cases of disturbance of the voice postoperatively. The external laryngeal nerve is one of the two divisions of the superior laryngeal nerve, a branch of the ganglion nodosum of the vagus high in the neck. This nerve (Fig 6) passes obliquely downward and medialward crossing posterior to both the internal and external carotid arteries to insinuate itself between the upper pole of the thyroid gland and the lamina of the thyroid cartilage. In this part of its course the nerve lies parallel with, and in very close relation to, the superior thyroid artery (Fig 6). It continues obliquely across the thyroid cartilage to innervate the cricothyroid muscle. This muscle raises and retracts the cricoid cartilage and therefore tenses the vocal cords. The exact rôle which this tension plays in the physiology

of a larynx is not definitely known. Hilton in his "Lectures on Rest and Pain," gives a theoretical explanation of this upward movement of the cricoid cartilage. In speaking of the motor branch of the superior laryngeal nerve, which supplies the cricothyroid muscle, he says "No matter how rapidly the nervous influence passes, it must reach the nearest point first, and that is apparently the reason why this little nerve takes so short a course to the cricothyroid muscle. It has long been my habit to regard the cricothyroid muscle as the muscles which are intended to tune the vocal instrument, and, as the instrument must be tuned before it can be played upon, so this nervous influence, first reaching the cricothyroid muscle, the vocal cords are put into a state of tension, preparatory to the more precise and accurate influence of the other muscles acting directly and indirectly upon the vocal cords." New cut the superior laryngeal nerve in 4 dogs and observed no effect on the vocal cords. However, it seems to the authors that the human larynx being a much more highly developed and sensitized organ than that of dogs, injury to this nerve in man with the consequent paralysis of the cricothyroid muscle, may cause more interference with the function of the vocal cords than the same injury in dogs. At least, the function of this nerve is worthy of further investigation in order to determine whether or not we are overlooking a definite anatomical structure, injury to which may be causing some of our postoperative vocal disturbances.

#### SUMMARY

1 This paper is based on a dissection of 200 thyroid glands and 400 recurrent laryngeal nerves in cadavers in the department of anatomy, University of Minnesota.

2 A special emphasis has been placed upon the relation of the deep cervical fascia inferior thyroid artery, and recurrent laryngeal nerves, from the standpoint of surgical anatomy.

3 The so called "capsule" of the thyroid gland formed from the middle or pretracheal layer of deep cervical fascia was not found to be as definite an anatomical entity as is usually described.

4 The intimate relations between the inferior thyroid artery, veins, and the recurrent laryngeal nerve, were noted and discussed

5 The reason for the indirect course of the recurrent laryngeal nerve is to be found in the embryology of this region

6 The recurrent laryngeal nerve was found to lie inside of the capsule of the thyroid gland when such was well developed

7 The closest relation between the nerve and the gland, and therefore the most dangerous area from a surgical standpoint, was found to be the posterior surface of the middle third of the lateral lobe of the thyroid, where the nerve was in direct contact with the gland

8 In 262 cases (65.5 per cent of 400 nerves) the recurrent laryngeal nerve passed posterior to the main branches of the inferior thyroid artery, in 104 cases (26 per cent) it passed anterior, and in 34 cases (8.5 per cent) it passed between the main branches of the artery

9 The position of the recurrent laryngeal nerve in relation to the vessels and adenomatous and substernal lobes varies greatly

10 The authors were unable to demonstrate any change in the position of the nerve relative to the gland by anterior displacement of the lateral lobes

11 The intimate relation between the external laryngeal branch of the superior laryngeal nerve and the superior thyroid artery and upper pole of the thyroid gland was noted, and its possible bearing on postoperative vocal disturbances discussed

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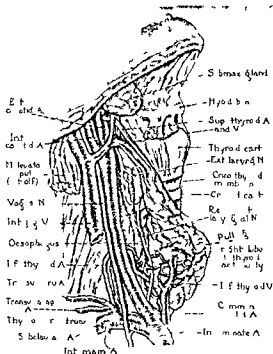


Fig 6 Lateral view showing normal relations of thyroid gland to surrounding structures. Right lobe has been displaced anteriorly to display the posterior relations of the recurrent laryngeal nerve, the inferior thyroid artery and veins. The clavicle has been removed.

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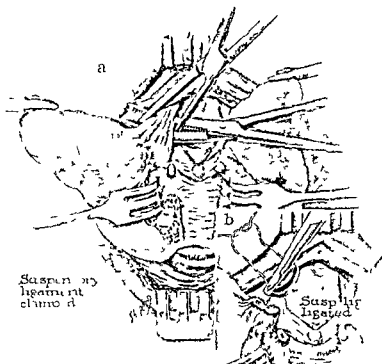


Fig 4 Exposing the binding fascial structures at upper border of right half of isthmus and ligation of suspensory ligament.

*Thyroidectomy — H M Richter*

# CLINICAL SURGERY

FROM NORTHWESTERN UNIVERSITY MEDICAL SCHOOL SURGICAL SERVICE

## THYROIDECTOMY

H. M. RICHTER M.D. F.A.C.S. CHICAGO

**T**HYROIDECTOMY is indicated in any form of toxic goiter irrespective of any theoretical considerations of the cause or antecedent factors leading up to the thyrotoxicosis. The indications have been greatly broadened in recent years because of a better understanding of the relation of the thyroid to many diverse clinical manifestations particularly cardiac disturbances. Long standing nodular goiters in the middle aged and aged, apparently harmless over a period of many years, have been found with increasing frequency to be the source of active though often atypical toxic symptoms. Mild toxic manifestations in the young especially during periods of unusual stress and strain, as in young college girls and at puberty, while constituting very definite evidence of possible future danger may yield to conservative measures. During pregnancy the basal metabolism is found quite consistently to rise above the average norm and not infrequently to be associated with moderate symptoms often bizarre. Iodine will usually relieve the symptoms or better still will prevent their development, when given prophylactically.

The indications for thyroidectomy for thyrotoxicosis are not limited by associated high grade cardiovascular damage or other complications. The existence of secondary damage may lengthen the period of preliminary preparation though never for more than a few weeks. No degree of mental aberration is a contra indication. My own cases include some who required physical restraint and were fed with the nasal or duodenal tube. Practically no complications render the condition inoperable.

### GENERAL CONSIDERATIONS

A rather remarkable difference of opinion exists as to the desirability or danger of preliminary ligation of the four thyroid arteries. Some feel that bilateral ligation of the inferior thyroid arteries must endanger the integrity of the

parathyroids, others find it entirely safe. Observation of the varying technique in use soon enables one to understand that it may be either safe or dangerous to ligate the inferior thyroids, depending entirely on the further steps of the method employed.

Surgeons who leave a considerable layer of thyroid tissue in front, and at the sides, of the trachea have no fear of bilateral ligation of the inferior thyroid arteries. The collateral circulation is ample for the security of the vascular supply. Thus continental surgeons, who in general have a far larger proportion of large non toxic nodular goiters than we do are more justified in using this method routinely. On the other hand, such a method must result in a very high percentage of recurrent thyrotoxicosis in the acute primary toxic types. Obviously one may not ligate both inferior thyroid arteries and at the same time make a clean dissection of the thyroid from the trachea. Such a procedure would frequently result in the development of tetany.

The discussion of the relative value and danger of preliminary delivery of the thyroid is based much more on the method of exposure than on any inherent danger in the delivery of the gland *per se*. With a satisfactory skin incision and a free median splitting of the strap muscles, most glands of moderate size can readily be relieved completely of restraining filaments of tissue and can be delivered at will without force.

In large goiters in goiters with unusually long superior poles, and particularly in the presence of substernal or thoracic extensions, free transverse division of the strap muscles is indicated. Their division between clamps was suggested many years ago by Charles Mayo, and this method is widely used. The clamps simplify greatly the control of the numerous ends and their resuture. They present however, the very considerable disadvantage of failure to permit adequate retraction of the muscles which after all is the purpose of their division. Complete transverse

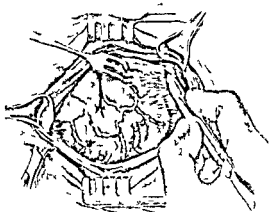


Fig 1 Pressing back the web like fibers of connective tissue at sides of gland

division of these muscles well out under the borders of the sternomastoid, without hindering clamps flattens the neck, so as to convert the goiter from a buried tumor to a projecting mass. Delivery of the cervical tumor ceases then to be a problem.

The amount of thyroid tissue to be left behind is seldom correctly described yet it is of vital importance in thyrotoxicosis. In non toxic goiters any moderate amount of the gland may be left. If one side is not involved, it may remain intact. In large nodular goiters it may be difficult to find sufficient normal thyroid to leave. In thyrotoxicosis the problem is quite different.

Here a minimal amount of the thyroid only may be left and in every case, without exception the persistence of any degree of toxic symptoms is absolute proof that too much of the gland has been left behind. Perhaps the greatest single cause of error in this respect is the tendency to visualize the amount of thyroid to be removed in terms of a fraction of the size of the gland as three fourths, four fifths, and so on. It is of basic importance to remember that not the fraction that we remove but the amount we leave behind determines the result. And the amount of thyroid tissue required to maintain function is remarkably small—probably only a few grams.

Another remarkable variation in the methods in use in different clinics is based on the need for so called 'multiple operations'. Under this head the operation is planned to be carried out in several sittings most frequently a preliminary arterial or polar ligation is done then partial or complete lobectomies to be followed by removal

later of the remaining lobe. Before the introduction by Plummer of the use of iodine in the preparation of the patient for thyroidectomy preliminary ligation of one or more vessels was carried out in an amazingly high percentage of patients in some clinics. Lobectomy as one stage of the complete operation is common practice today. The use of iodine has greatly reduced the number of two and more stage operations but there seems to me to be little purpose in any such procedures. The postoperative reaction is due essentially to leaving enough thyroid to develop such a reaction. Moreover, a radical thyroidectomy requires but little more time and inflicts but little more injury upon the patient than an incomplete operation. It would seem logical to remove the thyroid radically, leaving a minimum of tissue to develop the postoperative reaction so greatly feared.

#### PRE OPERATIVE CARE

Iodine in large doses as Lugol's solution is given for from 10 to 20 days. Actual improvement continues for a number of days after the patient's condition seems to have become satisfactory. It has seemed to me to be as effective in the nodular as in the primary hyperplastic type. In severe cases as after a crisis, it is especially well to let the patient become stabilized. Food and liquids are pushed. There is no object in restricting the use of any type of food as meats. Rest not necessarily bed rest is important. Body weight and metabolism should be watched.

#### TECHNIQUE

*Anesthesia* Thyroidectomy lends itself easily to block or local infiltration anesthesia. In non-toxic or well controlled patients, who are not excitable this method is very satisfactory. It is very desirable in the presence of any degree of respiratory difficulty from pressure. We have used it almost entirely combined with nitrous oxide oxygen anesthesia borrowing much from Crile in so doing but permitting the patient to become quite conscious during deep manipulations in the neighborhood of the recurrent laryngeal nerves. We proceed as follows.

The patient is placed comfortably on the table with the head extended the upper half of the table being elevated and the nitrous oxide anesthesia is started. After iodine preparation of the skin, the patient is draped and infiltration with one fourth to one half per cent novocain in normal salt solution is begun. The injection is entirely subcutaneous from thyroid cartilage to clavicles and from one sternocleidomastoid to the

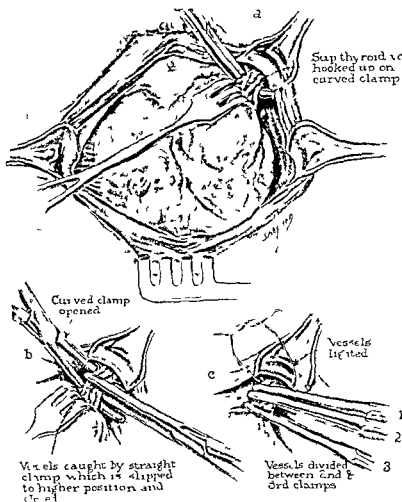


Fig 2 Steps in ligating the blood vessels

other. Besides the anesthesia the artificial edema thus produced is a factor in simplifying the dissection of the flaps. We formerly employed the method of Kulenkampf but found the deep injections unnecessary. The block anesthesia of Kappis is effective but also unnecessary. It may have a place in unusually large substernal goiters. I usually employ novocain solution without adrenalin but occasionally find it necessary to reinject the skin margins before suturing. Adrenalin may be added with advantage in all but the more toxic cases in the proportion of one minim of the 1:1000 solution to the ounce of novocain solution giving a strength of 1:500,000. I prefer one of the automatically refilling syringes which immediately warns of the puncture of a vein by drawing blood up into the barrel.

The operation is now continued under nitrous oxide anesthesia until the area of the recurrent laryngeal nerves is reached, when the patient is allowed to awaken and is held in conversation during the dissection of this area. Should the patient be entirely comfortable, the operation is continued and completed under the novocain anesthesia. Any material discomfort of the patient physical or psychic is considered an indication immediately to add nitrous oxide. Since we have used this nitrous oxide novocain combination and have kept the patient in conversation during the deep dissection the incidence of nerve injuries has fallen very satisfactorily.

**The incision.** The approach is by way of a free transverse incision at such a level as to permit the scar to fall into the hollow area of the neck above

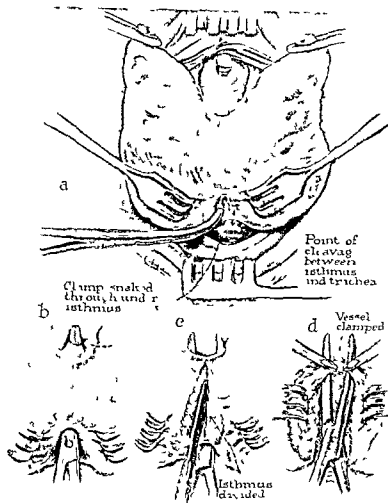


Fig 3 Dividing the isthmus the trachea is protected by forceps inserted between isthmus and trachea

the sternal notch. This incision includes the platysma, which is quite intimately blended with the skin and for the most part is not apparent as a separate layer. Its length should be ample to give adequate access and obviously must vary with the requirements of the individual case. It should be perfectly transverse or bowed slightly downward. In very large irregular nodular goiters the transverse incision should be relatively high, or the scar will fall below the intended line. Finally in exceptionally large goiters it may be desirable to give a strong downward curve to the incision. This gives a poor scar, but undoubtedly gives the best possible access and may be used where a damaged

heart and pressure dyspnoea add an unusual handicap.

Dissection of the upper flap is somewhat facilitated by the previous infiltration with novocain solution. It is freed well up to the notch of the thyroid cartilage. The lower flap requires less retraction or dissection but may be freed to the sternal notch in the midline. Where the anterior jugular or other large vein is accidentally injured it is best to divide it between forceps and ligate. The flaps are held back by means of a self retaining Beckman retractor.

**Exposure** The pre thyroid muscles are now separated by splitting in the midline throughout their full length, from hyoid to sternum. The

most superficial or sternohyoid muscles are readily separated and retracted, the underlying sternothyroids are very thin and often not readily recognized as a covering of the gland, unless definitely sought. They are best picked up in the midline and peeled back with the handle of the scalpel. Their upper ends do not reach as high as the sternohyoids, and they may easily be torn off by the careless use of retractors.

When the strap muscles are retracted the structure of the thyroid will stand out very clearly, leaving no room even for the novice to be in doubt as to his position. At the sides of the gland, web like fibers of connective tissue will be observed passing outward and backward. These bind and should be pressed back bluntly with the handle of the scalpel (Fig. 1), or a gauze sponge over the finger, etc. The important thing is that the gland should be dissected clean of all binding structures. Kocher recognized the importance of this technical step when he advised rather to cut into the gland than permit oneself to work outside the proper plane of cleavage (W. S. Halsted). If unusual exposure is required, the strap muscles may be divided transversely, as described above.

*Delivery of the gland.* The exposure of the side of the gland and the entire upper pole is greatly facilitated by the use of rake shaped, sharp retractors that are actually hooked into the gland instead of grasping the latter with forceps. For the idea of using retractors in this way I am indebted to Dr. Nelson Percy. An ordinary sharp three pronged retractor is used for this purpose. Hooking it into the outer side of the upper pole, usually the right pole first, we draw the latter gently downward and medianward making all binding tissues apparent when they are cut or pushed back as described. The pole is rolled progressively forward the entering vessels coming prominently into view. Any difficulty in exposing the pole is usually due to failure to free it of normal binding structures such as fibers of the lacerated sternothyroid muscle, or its adventitious capsule of loose connective tissue. Rarely an unusually long pole or one containing an adenoma may offer difficulties. Abnormal adhesions are never present except in the form of scar tissue resulting from previous operations. Their apparent presence is always due to the failure of the surgeon to keep within the proper plane of cleavage.

With the right pole delivered and held by the hook retractor a curved forceps is gently inserted under the moderately tense superior thyroid vessels passing from within outward as they present themselves (Fig. 2a). The forceps

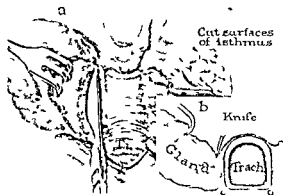


Fig. 5 The lobe is freed from the front of the trachea with sharp dissection. Insert shows knife shaving off thin layer to be left attached to posterior capsule.

may meet with some resistance but can be gently maneuvered under the vessels like a Kocher dissector, and then the blades being separated, the vessels are readily grasped with forceps (Fig. 2b). To insure against accidental loss of the vessels they are grasped with two forceps and a third for cups placed close to the pole itself (Fig. 2c). The vessels are then divided and immediately ligated.

The left pole is now treated in a similar manner, and the vessels are divided and ligated. The outer sides of the lobes are further freed downward toward the lower pole, until the free delivery of the latter is accomplished the same method of drawing the gland medianward with the pronged retractor while tensing and freeing the binding tissues from the outer and lower aspects of the lobe being used. This freeing process may be hampered by the lateral veins entering the outer border of the thyroid. If so, these are caught and divided between forceps and gland. While much mentioned I have never found them a material source of trouble. Blindly forcing one's finger between gland and muscles may rupture the veins, but this should not happen if care is used. During the delivery of the lobe no serious attempt is made to divide the capsule or reach the vessels of the outer aspect of the gland. Complete freeing except of the upper pole, is not contemplated. This can be done more readily at a later stage. No additional forceps except those on the lateral veins are applied to the lobe at the present time.

There is now a single forceps on the upper pole at the site of division and ligation of the vessels at times, a second forceps on the lateral vein on each side. Usually no other forceps are in position. The importance of forcing home this statement is



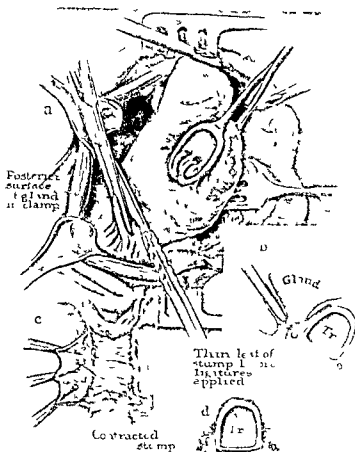


Fig 6 The forceps are inserted into layer of tissue left not behind it

based on the fact that the necessity for placing many forceps while the gland is being raised and freed is caused either by the surgeon wandering out of his proper line of cleavage in which case he may find himself in an interminable maze or by his fearfully grasping innocent structures in no need of forceps. There are no vessels in the proper plane of cleavage here described except as mentioned.

The superior poles are now free the lateral aspects of the lobe and the lower pole partly free. The gland is still firmly held throughout by its posterior surface and the inferior thyroid arteries are intact. Above the pyramidal process may extend well up to the hyoid bone. Extending upward from the isthmus is a rather firm binding tissue, an extension of the deep cervical fascia binding the gland to the larynx. Below a loose connective tissue extends from the lower border

of the isthmus and inner aspects of the lower poles to the trachea including superficially in its structure the median veins. The lower border of the isthmus is accurately located by the palpating finger and a Kocher dissector or a curved forceps is insinuated between isthmus and trachea gently forced upward to emerge beneath the upper border of the former (Fig 3 a and b). The trachea being thus guarded the isthmus is divided between forceps or better simply cut through without forceps bleeding being very satisfactorily controlled by making gentle traction with the hook retractors (Fig 3 c and d). Usually not more than a vessel or two often no vessel whatever requires attention. The isthmus varies greatly in size and vascularity but these bear no constant relation to each other.

The anterior surface of the trachea is now well exposed. Traction being made with the right

hook, the right lobe is gently everted and simultaneously the forceps originally placed on the right upper pole is raised. The effect is to make prominent the binding fascial structures at the upper border of the right half of the isthmus (Fig 4). The curved forceps is insinuated beneath this structure, separating it from the trachea. The jaws being opened, the moderately tensed tissues are grasped with forceps and divided between it and the gland. Continuing the eversion of the right lobe, it is freed from the front of the trachea with sharp dissection, all loose connective and capsular tissue being left behind (Fig 5). The knife edge then actually enters the thyroid (Fig 5b) shaving off a thin layer that is left attached to the posterior capsule. An occasional vessel will be cut before being caught, the traction of the hook retractor lessening the bleeding. Very little blood is lost. Usually the fibrous septa carrying the vessels can be recognized and caught before they are cut. Remarkably few vessels require attention. The placing of innumerable forceps progressively in the thyroid substance before cutting is thus shown to be entirely needless. At the inner lower border of the lower pole a forceps is pushed into the thyroid before it is cut. Frequently six to eight, usually not over ten forceps suffice for each lobe including the outer capsule of a fair sized hyperplastic thyroid.

In the final severing of the posterior surface of the lobes it must be emphasized that a layer of but a few millimeters is left, and what forceps are used are inserted into this layer, not behind it (Fig 6), thus following in principle the technique of Kocher, W S Halsted and Charles Mayo, described years ago. During the dissection of the posterior surface of the gland, the patient is permitted to remain awake and is kept in conversation.

The gland now is free except as it is held by the outer border of the capsule behind. This capsule is left to the last because the gland is now so well mobilized that in applying forceps a maximal amount of this tissue can be preserved with greater safety to the recurrent laryngeal nerve and better preservation of the parathyroids. The original Kocher goiter forceps make an excellent handle for manipulating the gland.

Right and left lobes are treated alike. The pyramidal process is usually removed with one of the lobes. When long it may temporarily be divided and the upper end removed on completion of the operation. In large substernal or intrathoracic tumors some difficulty may be experienced the equator of the thoracic portion being actually larger at times than the intrathoracic thorax. The freeing of the upper poles division of the suspen-

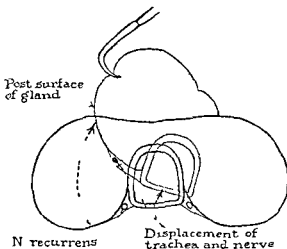


Fig 7 Displacement of recurrent laryngeal nerve and parathyroid bodies by traction on gland. Hence, danger to them from careless application of forceps.

sory ligament above the isthmus, and division of the isthmus must always precede any attempt at delivery. Great help is obtained by having the patient cough vigorously, traction being made from above simultaneously. Here again it is exceedingly important to sever all restraining bands, even the thinnest, as one proceeds. By bearing this simple procedure ever in mind, the impossible situation is completely changed, and what is at first an utterly immovable mass, rises progressively to the surface.

**Closure.** Before closure is begun the patient is asked to cough vigorously to start bleeding from vessels that may have escaped notice. Persistent oozing is treated by whipping over or through the thyroid stump—always with the patient conscious and talking. With the patient awake and quiet, injury to the recurrent laryngeal nerves may pass unnoticed. Nerve damage may be shown only on exertion or talking or coughing.

The neck is comfortably flexed, and the sterno-thyroid and sternohyoid muscles are accurately sutured if divided. No more difficulty is experienced in suturing the muscles than when muscle clamps are used. With the field perfectly dry, and air bubbles expressed to avoid dead spaces, the skin is now completely closed with a running subcuticular suture that I believe was suggested by W S Halsted in the early nineties. No drain is ever used as such. At times annoying oozing cannot readily be stopped. A small cigarette drain is then used to avoid a hematoma. Firm pressure, kept up by an assistant while the muscles are being sutured, helps prevent hematoma formation.

A snugly fitting firm binder is applied over a large elastic mass of gauze to continue gentle pressure for several hours after which it is removed a simple dressing remaining.

The routine use of a drain of any kind seems quite unnecessary. If not used a cleaner scar is left. A small serous effusion will occasionally develop but its evacuation with a sharp nosed forceps is a minor matter.

#### POSTOPERATIVE TREATMENT

The patient is returned to bed and placed in a semi sitting position. A simple sedative or morphine if required, is given as the occasion demands. Liquids are pushed. In the first 24 hours from 60 to 120 minims of Lugol's solution are administered. The amount is rapidly reduced to 10 minims daily, as the patient fails to show a post operative reaction and stopped when the patient leaves the hospital. Persistent nausea is probably of toxic origin and can be best combatted by means of large quantities of salt solution given subcutaneously, as suggested by Crile. Hypodermoclysis can be made relatively comfortable by Bartlett's method—adding 0.3 gram novocain (without adrenalin) to each liter of normal salt solution. Small needles are used and novocain is injected locally before the needles are inserted.

Food is added as the patient can take it.

#### SECONDARY OPERATIONS

Thyroidectomies following previous ligations or lobectomies present no special problems. It is frequently otherwise however, in cases of previous inadequate attempts at thyroidectomy. Here the combination of distorted anatomical structures binding scar tissue, irregularly distributed thyroid substance and in some cases damaged nerves or parathyroids may add serious handicaps. Pre operative laryngoscopic studies, tests for latent parathyroid damage and roentgenological studies of the chest for possible substernal masses are particularly important.

The first essential is to lay the field of operation widely open to inspection. The use of the scar of the earlier operation as the site of incision is usually preferable from the cosmetic standpoint. A very badly placed scar may have to be disregarded. The incision should be unusually free and the muscles well exposed. The latter should be separated in the median line and divided transversely if required exposing thyroid or trachea as early in the operation as possible. Working outward from the median line, the thyroid should be progressively freed of adherent scar and muscle. No uniform method of approach is possible, but

the various areas where thyroid is most likely to be left should be adequately investigated. Lateral masses, tips of the upper horns, the upper portion of the pyramidal process, and finally almost any part of the neck including the lateral and subclavicular areas, must be investigated. The danger of parathyroid and nerve damage is distinctly greater than in primary cases.

#### POSTOPERATIVE COMPLICATIONS

*Postoperative hyperthyroid reaction.* Ten years ago I wrote "The basic fault in the scheme of operation is to leave behind an amount of (pathological) thyroid capable of such excessive action." The radical operation here described is intended to avoid just that error.

Iodine has served greatly to reduce the incidence of postoperative reactions even with less radical procedures. When reaction occurs large doses should be given and liquids pushed rectal and subcutaneous routes being utilized. Crile has shown the danger of hyperpyrexia and the value of ice packs should it develop.

*Postoperative bleeding and hematoma.* This accident is relatively frequent and the amount may vary from a small infiltration to a serious hemorrhage with pressure. The bleeding may result from venous oozing or from active arterial bleeding. In any case with maternal hemorrhage or the formation of a sizable hematoma, complete re-opening of the incision and evacuation of the clot is essential. In the presence of active arterial bleeding, timid approach is dangerous.

The cause of active arterial hemorrhage is not always careless ligation. Altered vessel walls quite possibly are a factor in permitting a vessel to give way at the site of ligation.

*Tetany.* In the first days following thyroidectomy patients are uniformly examined for the presence of the Chvostek or Trousseau signs. The presence of these as indicating postoperative tetany is further confirmed by Erb's electrical reaction and the determination of the blood calcium.

Mere tingling or other mild discomfort is best treated by the elimination of meats and meat products from the diet and the giving of milk freely. Calcium in large doses is effective—calcium lactate may be given in 30 to 45 gram doses daily in milk or wafers. If given before meals on an empty stomach much smaller doses suffice.

If tetany develops to a substantial degree with spontaneous spasms, parathormone (Collip) should be given hypodermically at once—usually two or three doses sufficing and the diet as above maintained. To this diet 200 grams of lactose daily should be added.

The combination of calcium, lactose, milk, and meat free diet will control any case. If the symptoms persist, parathormone should be given from time to time to permit some comforting relaxation of dietary restriction. Ultimate recovery is the rule. Rarely, symptoms may persist for years.

The value of ultraviolet light and the various radiated oils, etc. is now being investigated.

*Recurrent laryngeal nerve injury.* This complication should be detected on the operating table and appropriate measures at once taken to sever ligatures which may have included the nerve. Occasionally a hematoma may give rise to pressure symptoms involving the nerves. Evacuation of the clot usually is followed by recovery.

When the injury is unilateral, time will improve the patient's condition. If incomplete, recovery will follow. Complete bilateral injury causes permanent disability. Edema of the cords resulting from trophic disturbances may render tracheotomy necessary. There is often remarkable freedom from dyspnea except on exertion. The voice may also be very satisfactory except for inability to raise it to a higher pitch. Occasionally postoperative tracheitis may be confused with recurrent laryngeal nerve damage—the diagnosis is made by laryngoscopic examination.

*Exophthalmus.* Exophthalmus developing or increasing as a postoperative complication is a most perplexing and, at times, serious condition. It is usually associated with hypothyroidism. Marked edema of the conjunctivæ with lachrymation may be present. The deformity is unsightly, the discomfort may be disabling, and corneal ulceration has developed. There is some tendency to recede, but progress is slow.

Treatment has been unsatisfactory. Metabolism should be maintained at normal. Iodine has been suggested. Large glasses or goggles as protection are important. We have had no experience with sympathectomy or orbital operations.

*Hypothyroidism—postoperative.* The type of radical thyroidectomy advocated in this paper will result in a high incidence of temporary hypothyroidism. This is to be desired for it definitely insures against failure to accomplish the surgeon's purpose—permanent relief from thyrotoxicosis. Gradually the process requiring from several months to a year or more, most patients return to normal. The period of hypothyroidism is one of discomfort that can be avoided by starting the patient on desiccated thyroid about the fourth week, varying the dose to meet requirements. Clinical symptoms and frequent basal metabolic determinations are the best guides.

# EFFECT ON THYROTOXICOSIS AND METABOLISM

The thyroid is essential to the existence of thyrotoxicosis. A sufficiently radical thyroidectomy must necessarily end the intoxication. Residual organic damage may remain but not active in intoxication.

The effect on the basal metabolism is the best single means of estimating the effectiveness of the thyroidectomy and of comparing results of treatment with other methods. For the purpose of this paper a recent consecutive series of 500 thyroidectomies was studied for the effect on metabolism. Only patients showing a substantially raised metabolism were included. Exceptions were patients thoroughly iodized just before coming under observation. Including these, less than 15 per cent were below plus 30. The average preoperative basal metabolism was approximately plus 46. Postoperative metabolism studies were made on 447 of these patients. Of these 443 were found to have a metabolism of below plus 15. Of the 4 whose postoperative metabolisms were above plus 15, one was a single metabolism of plus 16. One has been consistently normal, but at the last check up too late to be repeated in time for this paper he had a plus 20. He is probably not toxic. One has had a postoperative metabolism of plus 15 and plus 20 within 5 weeks of operation and is no longer available for further check up of her metabolism. One has had five postoperative metabolisms all consistently above normal ranging from plus 20 to plus 22.4 and is probably mildly toxic. Thus there has been one definite failure to secure normal metabolism in 447 consecutive patients available for study.

None of this series of 500 patients was subjected to a two step operation, one had a preliminary ligation. Many had been previously operated upon unsuccessfully elsewhere.

## MORTALITY

The very radical thyroidectomy has given a consistently low mortality. Before the introduction of iodine it ranged about 1 per cent. Since the introduction of iodine, the mortality has been further substantially reduced. There has been but one death in this series of 500 cases, more than 400 patients have been operated upon since the last death. There has also been a previous series though overlapping this series of well over 500 consecutive thyroidectomies with one death. Both series refer to patient mortality.

This low mortality is based on the principle reiterated above, of leaving so little thyroid behind that postoperative reactions are prevented, and on an entire avoidance of 'step' operations.

FROM THE DEPARTMENT OF SURGERY, UNIVERSITY OF CALIFORNIA

## CHOLECYSTECTOMY—MODIFICATIONS IN TECHNIQUE

STANLEY H. MENTZER, M.D., AND JOHN HOMER WOOLSEY, M.D., F.A.C.S., SAN FRANCISCO, CALIFORNIA

**I**N 1890 Courvoisier reported that 47 cholecystectomies had been performed to date. Since then cholecystectomy has become an accepted procedure although there have been many modifications in the methods of gall bladder excision. Even today the technique of cholecystectomy is not standardized, nor can it be, for anatomical and pathological reasons.

## INCISION

The choice of incision is great. The Bevan type has its admirers, the costolateral incision of the Mayos' gives excellent exposure, the transverse incision as used by Quain is very satisfactory, the ordinary right rectus incision has been employed at the University of California Clinic for years with great satisfaction, and more recently the new incision by Sloan permits equally as excellent exposure as any of the foregoing.

The one requirement of the incision, granted that it will admit exposure of the right upper quadrant of the abdomen is that it must be sufficiently large to allow the hand of the assistant to enter for retraction and still leave space for handling the gall bladder with modern instruments under direct vision. An ordinary right rectus incision 14 centimeters long is quite satisfactory.

## EXPOSURE

The ease of all biliary surgery depends upon the exposure (Fig. 1). It is obtained in a very simple but definite manner and yet from our observation, is not well understood. The secret is in the manner of placing the moist tape pads and the manner in which the assistant holds his left hand so as to retract the stomach, duodenum, omentum, and hepatic flexure of the colon. Moynihan has said regarding this maneuver: "The placing of the hand in the exact position necessary to secure gentle traction of all viscera away from the common duct is in many respects the most important single detail in the operation." It is done in this manner: One or two moist tape pads are placed over the hepatic flexure of the colon and forced gently downward, a second and sometimes a third tape pad is placed along the mesial side of the gall bladder fossa so as partially to force the omentum and stomach to the left; another tape pad is now spread out over the duodenum and

pyloric region of the stomach and against the latter, the assistant who stands to the left of the patient, places his left hand, with the fingers well spread apart. Gradually the assistant works the fingers of the retracting hand down to the posterior abdominal wall, hooks them and then retracts the viscera along the mesial side of the gall bladder fossa well over the left. As a rule the entire hand will need to be within the wound with the palm being utilized as the body of the retractor and the fingers slightly hooked so as to give greater tension or to increase tension on the stomach, colon, and omentum at the base of the operative exposure. This maneuver, with the hand flexed at the wrist, allows the entire hand to be utilized in the retraction. The fingers placed in deeply against the posterior abdominal wall with slight hooking prevents what usually occurs: a creeping back of viscera at the base of the operative exposure.

The success of the exposure is dependent more upon this maneuver and the maintenance of it than on all other steps. It is well also to place a small amount of gauze packing in the very bottom of Morrison's pouch for it serves to absorb any bile that might accidentally spill during the operation and also serves as a contrast in color thus aiding in the identification of the overlying structures of the cystic duct region (Fig. 2).

The severance of the round ligament of the liver and traction upon this will at times be of tremendous aid in evertinating the liver and in maintaining the exposure thus exposed. The use of the operating table, kidney lifts, pillows, breaking of the table to aid in exposure of the liver and the use of gauze packing in the intraperitoneal space above the liver to hold it partially eviscerated are as a rule in our opinion unnecessary.

Finally, a relatively broad hemostat, such as a 5 inch Péan (Mayo pattern) is placed upon the neck of the gall bladder for traction purposes. If the surgeon now pulls gently upon this hemostat the cystic duct region will be put on stretch. The assistant, coincidentally, with a sponge stuck in his right hand presses the edge of the lesser omentum in the region of the cystic duct mesially. This gives an excellent exposure of the operative region.

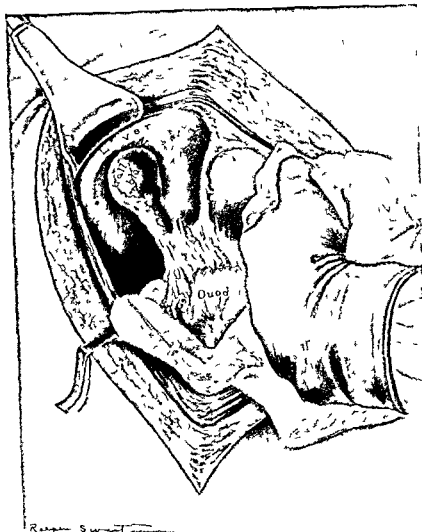


Fig 1 Exposure obtained with the use of the entire hand

#### IDENTIFICATION OF THE BILIARY DUCTS

Flint has demonstrated that the biliary apparatus of only about 30 per cent of persons conforms to the normal as pictured in the texts of anatomy. The marked variations in the duct and vascular arrangements of the biliary tree make it imperative to identify the major structures before irreparable surgery is performed. This can be accomplished only by exposing the ducts adequately. The cystic duct should be liberated from the adjacent tissue until it can be traced from the gall bladder to its junction with the efferent duct. This latter may be the right or left hepatic duct, the common hepatic duct, or the duodenum. The cystic duct may make a partial or complete cir-

cuit about the right hepatic duct or even around the common duct and so bewilder one in its course that identification is possible only after complete exposure.

The common duct is occasionally indistinguishable from the portal vein or from a right or left hepatic duct, especially one that has its termination close to the ampulla of Vater. Identification is often difficult because of adhesions or adjacent inflammatory structures. In these instances the bile duct can be definitely recognized by exploration with a syringe and small needle, aspirating from the structure in question.

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Fig 4 Manner of double ligating the duct with transfixion duct suture

use a cautery or to sterilize the cut end of the duct for bacteriologic studies have shown that bile is as a rule sterile and the duct walls free of organisms. In cases of acute empyema or cholangitis, however, cauterization is advised.

The cystic artery when it lies close to the cystic duct is caught and tied with the latter. As Eisen drath and others have shown, however, the cystic artery has so many anomalous courses and branches that it is often not secured in this manner. Therefore in such instances, a careful study of the fatty tissue immediately behind the cystic duct should be made. Certainty of ligation of this artery is important for severe hæmorrhage may otherwise occur.

We have tried many methods of ligating the duct and artery and have found that a single strand of No. 1 chromic catgut tied with three knots, that is a reinforced reef knot, is best. We secure it in place by a transfixion duct suture

adapted into a second circumferential ligation on the duct distal to the first (Fig 4). The second knot is thereby held securely in place and the first knot is unable to slip off because it is held in place by the second. The suture does not endanger bile leakage for there is ligation proximal to it. The artery is likewise at times doubly tied. As a further precaution, the omental edges are often stitched with a suture or two over the stump of the cystic duct. In this way every possible oozing point is secured and there is no possibility of bile leakage from untied accessory ducts other than those entering the side of the gall bladder from the liver in the gall bladder fossa. Although these are not common they are diligently searched for and tied before the liver fossa is peritonealized.

#### REMOVAL OF THE GALL BLADDER

McWhorter in describing the dissection of the gall bladder, remarked "Where the tissues are



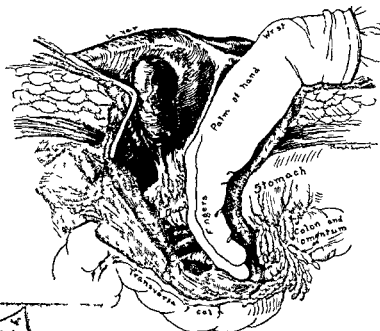


Fig 2 Profile view showing the retracting hand in place and fingers hooked



Fig 3 Extension of lesser omentum over on to gall bladder

duodenum This fold is a prolongation of the lesser omentum but is frequently wrongly interpreted as evidence of inflammatory changes (Fig 3) This is found in about 12 per cent of routine autopsies

The peritoneum and underlying fat is then incised and stripped away from the duct so that their courses can be adequately traced This is best done by blunt dissection We expose the cystic duct to its junction with the efferent duct and identify if in doubt the course of the right hepatic duct from the liver If this is done no mistake can be made in ligating the proper duct

#### LIGATION OF THE DUCTS AND ARTERY

Little difficulty is encountered in clamping the cystic duct if it is long and empty The short duct however especially when filled with small stones may prove troublesome We have found the small right angled clamp of Mixer helpful The duct already isolated is elevated by hooking the L-part of the clamp under it A similar forceps grasps the duct about 0.5 centimeter from its juncture with the common duct and a second clamp (usually the one used to elevate the duct) is placed parallel and distal to it The duct is severed between clamps with a scissors or knife It is rarely necessary to

folded in naturally by the apposing liver edges when all traction is ceased and the liver allowed to return to its normal position. Otherwise a running suture of No. 00 plain catgut approximates the peritoneal flaps over the raw area.

Blood vessels, if sufficiently large, should be ligated, but parenchymatous oozing can, as a rule, be quickly controlled by a hot, moist pack left in contact with the area operated upon for the ordinary clotting time, three minutes.

#### DRAINAGE

We have found it possible to close the abdomen without drainage in about 70 per cent of our cases. When drainage seems advisable we prefer rubber dam (Penrose type) or occasionally a dressed tube, brought out high up through the abdominal wall by way of a lateral stab wound. Separation of the wound edges occasionally follows drainage through the operative incision.

Most of our cholecystectomies are performed under nitrous oxide oxygen or ethylene anaesthesia. With ether anaesthesia, bile flow is retarded and the finer bile channels can be severed without cognizance. Occasionally when the patient has awakened from this type of anaesthesia and when the liver begins to function actively again, a biliary peritonitis may occur and even reoperation become necessary. With nitrous oxide oxygen anaesthesia and apparently with ethylene the liver continues its activity, and severed bile ducts especially in the liver fossa, can be detected and ligated before the abdomen is closed. This is of course the most important feature of non drainage (Fig. 6).

Drains leading directly from the stump of the cystic duct are apparently responsible for bile leakage in many instances, probably because of irritation or erosion. Long catgut strands left after tying the duct and used as drains have been pulled off with dressings and the catheter drain threaded over these long ends has been especially pernicious. Drains of these types only irritate the duct stump and predispose to bile leakage. For this reason we cover the stump of the duct with omentum and lead rubber dam or cigarette drains from the liver fossa rather than from an area near the cut end of the duct.

#### SUMMARY

1 The method utilizing the hand to retract the mesial side of the wound and operative field is the most important point in the exposure.

2 Absolute identification of the biliary ducts is essential.

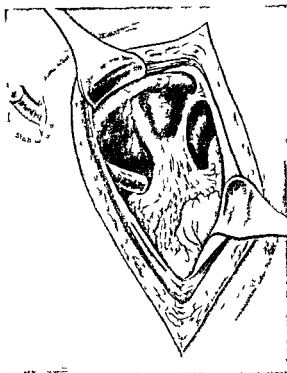


Fig. 6 Drainage by stab wound

3 Double ligation with the transfixation duct suture of the severed duct insures permanent closure.

4 The injection of the gall bladder bed with an isotonic fluid aids in the dissection.

5 Closure without drainage is preferred whenever possible.

6 Drainage by a high stab wound rather than through the operative incision offers a better opportunity for primary closure.

7 The use of gas oxygen or ethylene anaesthesia instead of ether assists in determining the dryness of the operative field.

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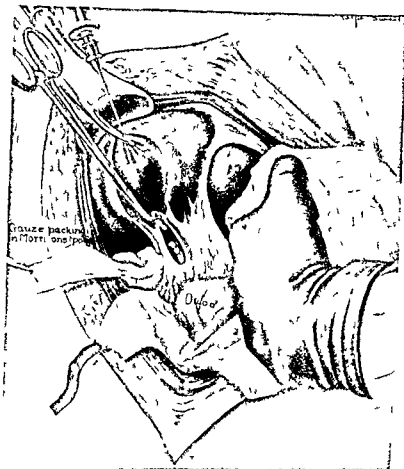


Fig 5 Injection of fluid in the gall bladder bed to aid in dissection

œdematous and the gall bladder thickened and friable the tissues separate very readily." Edema thickens a fatty connective type of tissue gives thereby a wider space for dissection and aids the finger or the instrument, if desired in finding more easily a line of cleavage. One can produce such an œdema between the gall bladder and the underlying liver by injecting normal salt or Ringer's solution just beneath the gall bladder (Fig 5). Dexterity in this procedure is easily acquired by experience. It is of especial advantage in cases of moderate cholecystitis or of cholesterosis. The complaint that it temporarily blocks blood vessels, allowing hemorrhage later has not been found to be true in our experience. On the other hand, in the dissection of the gall bladder from the liver it is of aid in protecting blood vessels of any size from breaking off flush at the liver and will,

as a rule, leave a protecting layer of loose connective tissue in the gall bladder fossa. Leakage of bile from exposed liver radicles occurs rarely, certainly far less than with the usual dissection. Therefore just preceding the dissection of the gall bladder from the liver 10 to 20 cubic centimeters of normal salt solution is injected with a 6 centimeter needle so as to infiltrate the entire gall bladder bed the injection beginning at the fundus and gradually advancing.

The peritoneum which is reflected from the liver upon the gall bladder, is now severed so as to allow approximately 0.5 centimeter or even more to remain on the liver side. Then the clamp upon the duct is held taut and the index finger gradually separates the gall bladder from its bed. In many instances the peritoneal flaps will completely cover the dissected gall bladder fossa and be



Fig 1. Covering of a granulating surface that resulted from the removal of a flap  
 A left The process of restoration of the lining of the cheek following the destruction of a wide spread verrucous growth of the buccal mucosa in a patient 34 years of age. This case is an excellent instance of the advantage of an available speedy method of covering defects from which flaps have been taken. If drawn together or allowed to heal these defects are ugly and in this instance would have distorted the neck tissues. The cheek wound was closed and the remaining part of the flap was returned to the neck. The granulations were then cut off down to a yellow scar base and a thick split graft sewed into place and fixed with a roll of gauze sutured firmly over it. B The result of grafting after about 2 months.

thinner graft is laid on a freshly denuded scar base on derma, on the periosteum or on bare bone or if the grafted area is surrounded by tense skin or scar there may be little subsequent narrowing of the field. If the thinner graft is cut so as to include an appreciable amount of the derma it seems to possess more of the good than the bad points of either the full thickness or the true Ollier Thiersch graft and it is this type of graft which we shall discuss here.

Having categorically presented the short comings of the thick split graft it is only fair to reiterate its redeeming qualities. A graft of this type of large size can be easily obtained with relatively little damage to the area from which it is cut the take is almost certain and if judiciously used such a graft gives good protection and a fair final appearance. A graft aggregating one hundred square inches will heal as quickly and surely as one an inch square and not a great deal more time is required for the cutting. Further, unless one cuts too deeply the defect resulting from the removal of one hundred square inches or more of graft will heal as quickly as that from a square inch graft. The more accurately and evenly the grafted area is covered the more will the result approach the normal condition.

#### TECHNIQUE

*Preparation of areas to be grafted.* Acute purulent skin eruptions or acute pus infections of any kind are contra indications to any plastic operation and especially to free skin grafting. Therefore a careful examination of the skin of the entire body is made before and on the morning of operation. A pimple or a boil even on a remote part of the body with sufficient induration to suggest the possibility of tissue necrosis or core formation means that the host's resistance to that organism is low at that particular time and we regard such a remotely located pimple, boil or impetigo as a contra indication to skin grafting. Acute tonsillitis is also a contra indication. Almost all of the failures in our experience we have attributed to an unrecognized or an immediately developing infection of this kind. The chronic acne pustule the simple inflammation about a comedo and the acute pustule without induration are not regarded as sinister and receive little consideration unless they are located on the field of operation. During the periods of pre-operative preparation all pustules as they appear are treated by means of small pieces of adhesive plaster placed over them and allowed to remain until the lesion dries up or discharges. Autogenous vaccines are used for recurrent staphylococcus infections, for the staphylococcus aureus haemolyticus infection we have used the specific antitoxin recommended by Parker and prepared by Eli Lilly & Com.

THE USE AND USES OF LARGE SPLIT SKIN GRAFTS OF INTERMEDIATE THICKNESS<sup>1</sup>VILRAY P BLAIR M.D. F.A.C.S. AND J. B. BROWN, M.D. St. Louis, Missouri  
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**E**ARLY, quick, and permanent surfacing of burns and other cutaneous defects conserves health, comfort, function, time, and money, while unnecessary waiting spells economic waste.

The factors that might lead to a choice between the use of flaps or of free grafts are not presented here, but having decided in favor of the latter, we should give serious consideration to the type of skin graft to be employed.

Next to the pedicle or sliding flap, a successful free skin graft of practically full thickness will most closely duplicate the natural surface, but a number of circumstances must be considered in each case: the type of the graft best fitted for the particular loss, the speed of the operation, the source of the graft, and the potential healing qualities of the patient—all have a bearing.

The full thickness graft is appropriate for a freshly made, clean raw surface where substantial protection, maximum mobility, minimum of subsequent contraction, and the most natural appearance are essential to a successful result. Circumstances permitting, the full thickness graft has usually been chosen to cover a contracted healed surface, in which the full thickness of the scar must be cut through or removed to allow relaxation. Such an area may be situated on the front of the neck, on certain parts of the face, over the flexor surfaces of joints that can be extended, or the extensor surfaces of joints that can be flexed. The full thickness graft is also used in the correction of webbed fingers and for the release of arms fixed and grown to the trunk as the result of a burn. On fresh granulating surfaces on freshened scar surfaces in contradistinction to scar surfaces which have been completely excised on surfaces that will resist subsequent contraction or in which allowance can be made for such contraction if the appearance and demands of function do not contra-indicate their use, thinner grafts are chosen because of the comparative simplicity of their application and the greater certainty of the take. On the back of the hand except over the knuckles and upon the subcutaneous muscles of the face, the orbicularis oris and orbicularis palpebrarum, a split graft of some thickness is in most cases the one of choice. Circumstances may make it necessary to vary

any of these rules. The technique of application of the full thickness graft and its after-care are both exacting and time-consuming. The graft itself is very susceptible to infection so that the patient must possess good healing power. The wound produced by the removal of the full thickness graft must subsequently be closed.

The Ollier Thiersch graft is theoretically supposed to include little more than the epithelial layer.<sup>2</sup> If given half a chance such grafts will heal in close to 100 per cent in areas which are only relatively clean and in patients with somewhat lessened healing power. While it requires considerable time and skill to obtain a good full thickness skin graft of any size, very large thinner grafts can be quickly cut and if one does not go too deeply and the dressing is properly applied the resulting raw area is usually healed within 10 days when the first dressing is removed. In most instances it requires 3 weeks of exacting post-operative care to carry through a full thickness graft, but the successful thinner graft at most requires only protection for a few days after the primary dressing is removed. In many cases moreover, if one wishes to form a lining for the antrum or for the conjunctival sac or to form a surface over de-epithelialized derma or the orbicularis oris or orbicularis palpebrarum, this lack of thickness of the graft is a very desirable quality.

Three factors associated with the use of the thinner graft, if inaptly applied, may seriously affect the final result: (1) the thinner graft may not give sufficient protection to a bearing surface; (2) the thinner graft, because of its thinness, will not correct the inequalities of the underlying surface, and (3) the thinner graft, if placed on a freshly made raw surface with a movable base and movable edges, such for instance as the subcutaneous tissue of the neck, may subsequently contract without any loss of epithelium and the contraction may be as much as 60 per cent.

Contraction does not take place in the graft itself but in the layer of scar tissue which unites the graft to its new bed. In the full thickness graft the derma seems to a large extent to have the power to resist this potential contraction. If the

<sup>1</sup>The type of graft was described by Ollier in 1885 and by Thiersch in 1886. Lawson (1887) described the use of the large thin graft. The type of graft was described by Ollier in 1885 and by Thiersch in 1886. Lawson (1887) described the use of the large thin graft. The type of graft was described by Ollier in 1885 and by Thiersch in 1886. Lawson (1887) described the use of the large thin graft.

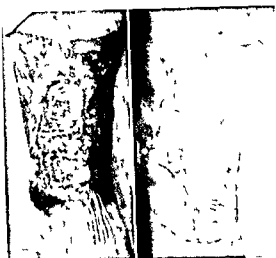


Fig 4 Burn scar spontaneous ulceration 50 years later. Clinically cancer unconfirmed by microscope. A left Chronic ulcer which had been present for 5 years in the scar of a burn the patient had received at 5 years of age. He is now 60 years old. The process appeared malignant clinically and there were large gland masses in the groin. The discoloration is due to mercurochrome which was used in cleaning up the ulcer. Amputation was advised but refused. Under local anesthesia the whole area was excised with a cutting cautery which penetrated the popliteal fascia in places. This allowed retraction of the surrounding skin edges and the defect opened up to about one half again as large as shown in A. This relaxation also allowed full extension of the leg. Balsam of Peru and iodoform gauze were sewed over the defect and a posterior plaster shell put on. This dressing was removed on the eighth day and mercurochrome packs were reapplied. Four weeks after the first operation the apparently clean granulating wound was covered with grafts taken from the abdomen and chest after the granulations were sliced off as described in Figure 3. Healing was complete in 2 weeks. B Result 5 months later.

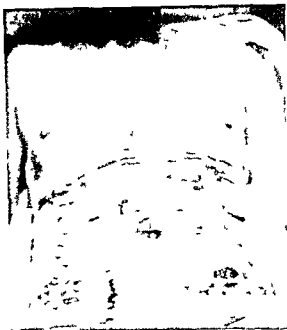


Fig 5 The abdomen as a source of split grafts. The abdomen of the patient whose leg is shown in Figure 4 showing the wide areas from which grafts can be cut with the aid of the suction retractor. There were only a few raw places left at the time this photograph was taken 10 days after the cutting of the grafts. We prefer to use general anesthesia when such grafts are cut. Even in debilitated patients probably less shock results than if an attempt is made to infiltrate a large area with novocain. A light analgesia is sufficient and with nitrous oxide the patient is usually awake and co-operative at the time the grafts are sewed on. If this part of the operation is done under local anesthesia. We have been able to cut grafts with the patient fairly deeply under hyoscine and morphine, but this procedure is not uniformly applicable.

of a sinus of the tonsils of the mucosa or about a tooth. We avoid turning subacute infections about the teeth into acute conditions by what might be called ill advised trauma the result of too energetic mechanical cleansings or extractions. We ordinarily regard as sufficient preparation the cleansing of the mouth with the tooth brush and a soapy tooth paste and with a simple mouth wash such as hypertonic salt solution.

The preliminary preparation of bare and granulating areas including indolent ulcers. Unless it is the site of an aggressively active infection or of a locally impaired circulation a granulating surface will in time epithelialize spontaneously but except for small defects this is a waste of time and money. Ordinarily in a patient of fair health sluggish or dirty granulations can be quickly cleansed by absorbent dressings dampened with some sort of an aqueous solution changed every 8 hours by rest and by postural control of the return circulation. So

long as it is non irritating the exact nature of the solution is probably not of great consequence. The important factors are (1) that the dressing be damp and absorbent not sloppy or allowed to dry in place, (2) that it be changed sufficiently often (3) that it be firmly and comfortably applied. Regardless of the chemical content of the solution the primary object is continuous drainage and pressure control of the circulation both within the granulations and in the associated area. Where the facilities are available and the staff is familiar with the technique, chemical sterilization checked by frequent counts is undoubtedly a valuable adjuvant to wound cleansing and healing but unless accurately done and unless its true objective and its limitations are appreciated it may cause more harm than good. In the Carrel Dakin technique the fluids bathe the raw surface directly and moisten the gauze secondarily which probably accounts for its high average of effectiveness when properly applied. Fluids repeatedly

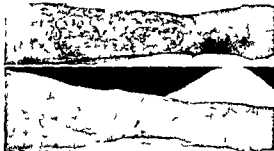


Fig 2 Ulcers in a heavy scar base primarily luetic 20 years duration without healing. A above. For 10 days a wet dressing was applied to the leg every day in the out patient department to save this amount of hospitalization. The patient a woman aged 34 years was then kept in bed in the hospital for 3 days and the dressing changed twice daily. At operation the areas were excised including the indolent edges all around. After clean excision of each ulcer base there remained a smooth yellow scar base that bled profusely. This bleeding was stopped by means of compresses held on while the grafts were being cut. The grafts were cut from the thigh the suction retractor being used and were made large enough so that only one graft was necessary for each area. They were sewed in place under normal tension multiple holes were stabbed through them and a firm sponge pressure dressing was applied. A posterior plaster shell was then put on for support. B The leg 1 year later. There was practically a full take and healing was complete in 10 days. This was the first time the patient's leg had been healed for 20 years. She was kept in bed for 3 weeks after operation and arrangements were made for convalescent care so she could continue to keep her legs at rest because it was thought that the enforced rest was an important factor in the successful outcome. She remained at the convalescent home but one week however and returned to her household duties. Supportive bandages were worn and she got along splendidly. A piece of adhesive was pulled off her leg after she was discharged from the hospital and a small ulcer developed in an area adjacent to one of the grafts. This area was cleaned up and successfully grafted 4 months later. She is now seen regularly a supportive bandage is worn and she is encouraged to stay off her feet as much as possible. She is thoroughly appreciative of the relief from the 20 years burden of the ulcers. On these scar surfaces where the skin is thin and of poor texture adhesive should not be applied and when crusts or scales form they should not be picked or scraped off but left alone or covered with a mild ointment.

pany. Ultraviolet radiation and blood transfusions are frequently resorted to and every effort is made to improve the general hygiene of the patient with particular attention to exposure to sunlight.

For preparation of healed cutaneous areas ordinary cleansing care the removal of all scurf or scales the day before operation and the use of some antiseptic solution in the operating room are sufficient.

Unless the staining is objectionable picric acid is used on surfaces that will not be exposed. On the face neck arms and hands iodine 3½ per cent is applied twice and removed with alcohol. If the graft is to be near the eye the conjunctiva should be prepared by the application of fresh 1 per cent

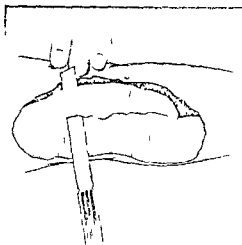


Fig 3 Shaving off granulations. Checked up observations show that the take would average much nearer perfect on a scar base prepared by shaving off granulations than on the natural surface of granulations. The granulations are not scraped but sliced cleanly down to a firm yellowish scar base which is found below the depth of the velvet. Before the area is sliced it is outlined with a scalpel just within the surrounding skin or scar so as to give a definite sharp outline to the denuded surface. Surfaces covered with healed scar are removed in the same fashion the surface scar epithelium being cut off first and then the deep scar sliced through layer after layer until a yielding well vascularized deep level of scar is exposed. When this decortication is completed if the defect is surrounded by normal skin it will have expanded approximately to the size of the original defect and this will allow the distorted surrounding parts to return to their natural positions (Fig 16).

mercurochrome. In operations about the face done under local anesthesia before the field of operation is prepared, 2 drops of 4 per cent cocaine are put in each eye to prevent pain should the iodine and alcohol enter the tarsal fissure.

On a moist mucous membrane it is questionable whether a single application of a chemical solution is more effective than a simple douche. A healthy mucous membrane is very resistant to traumatic infection and needs no surface sterilization. The mucosa especially of the nose and mouth is more susceptible to chronic inflammation than is the skin and if any preparation other than simple cleansing is indicated it should be in the form of treatment rather than in an attempt at direct sterilization. We do use weak chemicals in the conjunctiva but put little reliance in them except as a douche. We use iodine in the vestibule of the nose because it is skin lined. In the absence of acute inflammation we believe that it is permissible from a practical standpoint to regard organisms even in a foul mouth as not pathogenic to that person at that time. We do not operate in the presence of an acute inflammation.

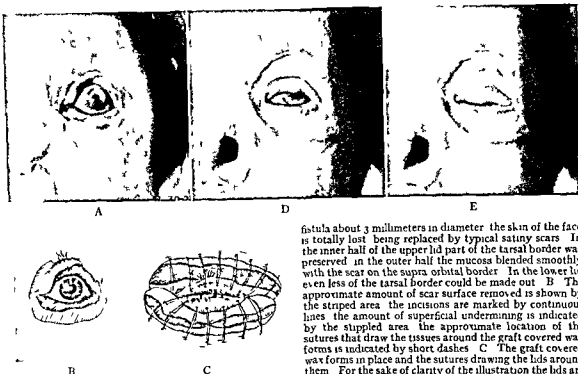


Fig 10 Total destruction of skin of the face and obliteration of anterior nares. At one sitting the left upper and lower lids and the nasal cavity have been restored with thick split grafts. A Photograph taken 1 year after beginning active treatment. This patient a woman aged 50 years had allowed hectic destruction of the face to proceed for 3 years. The ulceration has stopped and there is complete scar healing but there is complete ectropion of all four lids and both lips the external nose is all gone the nasal passage for a depth of more than a centimeter consists of a

fistula about 3 millimeters in diameter the skin of the face is totally lost being replaced by typical satiny scars. In the inner half of the upper lid part of the tarsal border was preserved in the outer half the mucosa blended smoothly with the scar on the supra orbital border. In the lower lid even less of the tarsal border could be made out. B The approximate amount of scar surface removed is shown by the striped area the incisions are marked by continuous lines the amount of superficial undermining is indicated by the stippled area the approximate location of the sutures that draw the tissues around the graft covered wax forms is indicated by short dashes. C The graft covered wax forms in place and the sutures drawing the lids around them. For the sake of clarity of the illustration the lids are not shown drawn out as far as they should be. These wax forms are so shaped that when in place they are braced against each other so that they do not press on the globes. By this precaution both lids can be grafted at one sitting. D E Condition 20 days after operation showing a single nasal passage of sufficient size preliminary to making a new external nose the amount of opening and closing of the lids and the area grafted. The operation here shown conforms in a general way to the plan described by Gillies under the heading of out lay graft of the eyelid.

applied to the surface of infrequently changed overlying gauze probably have little douching effect on the raw surface and may never penetrate the film of secretion which normally coats all granulating or infected areas. Unguents, while they do not impede circulation seem to lack the desired stimulation to granulation (Figs 1 and 2). Bad odor can usually be killed by a simple application or irrigation with a 1 or  $\frac{1}{2}$  per cent solution of formalin preceded by an application of weak cocaine to prevent pain or the use of gauze impregnated with balsam of Peru and iodoform. A paste of lactose and dextrin in butter milk to produce the bacillus acidophilus is a more complicated and less sure way to obtain the same result.

Success or failure in the use of grafts will depend more upon the healing qualities of the tissues than upon all other factors and influences combined, including good surgical technique. To secure the maximum benefit from a chemical antiseptic applied to the skin or raw tissues, it is imperative

that special attention be given the primary factors already mentioned, and if the strength of the solution lessens tissue resistance then it is best to discard it entirely. A firm, bright red, easily bleeding granulating surface that has but a slight mucus like discharge and is free from surrounding induration or inflammation possesses a high potentiality for healing, and such granulations can usually be obtained by the simple plan of rest and frequently changed moist dressings as already described. Thin or moderately thick skin grafts have a distinct tendency to grow when put on such a granulating surface, but they will do much better if the granulations are sliced (not scraped) down to the underlying yellow scar base and the whole area is covered with large grafts put on with proper tension and pressure (Fig 3). If it is desired to use full thickness grafts it may be safer to cover the raw surface first with thinner grafts and to apply the full thickness grafts after the





Fig 6

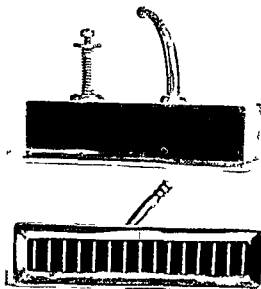


Fig 7

Fig 6 Knife and razor. The blade of the knife is 18 centimeters long and 2 centimeters wide. It is made of a strip of razor steel set into a stiff back and the whole thing is made very light. It can be stropped on a piece of canvas but will have to be ground occasionally. The razors are regular barbers' razors with the heel and toe rounded and sharpened so as not to hang in the skin while being used.

Fig 7 Suction retractors. These are hollow brass boxes with the underneath side open for application to and suction on the skin. Boxes of three different lengths of opening are used—4.5, 7, and 9.5 centimeters—for application to different areas, the smaller one being especially useful for obtaining grafts from the abdomens of infants and children. Just within the opening there is a series of transverse bars which prevent the skin from being drawn bodily up into the box. The ends are corrugated for gripping and are 2.5 centimeters square. A tube leads from the top of the box to be connected to a non-collapseable rubber tube connected to a strong suction machine. There is a spring valve on top of the box with a screw for the adjustment of the strength of suction. The suction usually used is a half of an atmosphere of negative pressure.

Fig 8 Use of the suction retractor. We always feel apologetic for using a special instrument but believe this suction retractor has some justification. While this machine in its present form is not a substitute for manual dexterity in cutting grafts, repeated comparisons have convinced us that with it one is enabled to cut grafts more quickly to make them larger and of more uniform thick-



Fig 8



Fig 9

ness and to make them of almost any desired thickness—all of which widens the field of usefulness of these grafts. It also enables one to cut large grafts from areas that ordinarily cannot be made available as sources of split grafts, such as the rapidly moving abdomen of a young baby. A very thin film of vaseline is applied to the donor area and gently wiped off with a gauze sponge. Too much vaseline allows the box to slip too easily with too little it will drag and cause ecchymosis. One end of the field is fixed with the edge of a flat pan in the hands of an assistant. The knife as shown in Figure 6 is used. The suction retractor is drawn slowly along the surface, neither raising nor depressing the skin. However when grafts are cut from the abdomen it may be advantageous to lift the skin slightly to get the correct tension. In the present form if the box is allowed to remain stationary in any particular place or is moved too slowly along the skin too much pressure may cause streaks of dermal edema, which will be registered in the form of thicker streaks in the graft.

Fig 9 Sewing on graft. Application of graft to prepared surface. It is cut large enough to overlap the edges (which may be reefed back on themselves to enlarge the area grafted and thus try to prevent subsequent edge scar) and is basted or whipped into place all around with a running horse hair stitch, practically normal tension being maintained on the graft at all times. Whipping into the edge of the defect is probably the more satisfactory. Multiple stab wounds are put through the graft with a pointed knife to allow the escape of blood and serum. (These allow slight relaxation of the graft.) Before the dressing is applied any blood clots underlying the graft are expressed from beneath it with a roll of gauze. These thick grafts may leave a more pronounced scar along the edge than the regular Thiersch graft but as shown in many of the illustrations they usually flatten out satisfactorily in fact the excess thickness may even tend to prevent keloid formation.



Fig 13 Lip ectropion due to burn scar released and grafted A left Boy of 16 years was burned at 2½ years with resultant ectropion of lower lip and scarring about face The scar was released and a very large thick split graft put in place over a wax form B The result 20 months later Note the straightened corner of the mouth and the quite smooth surface of the graft There had been a secondary excision of the edge along the vermilion border of the lips but the other edges are those of original union of the graft

*Application of grafts* The grafts are applied as soon as the bed is prepared Definable arterial or venous bleeders of any size may be caught and tied with split silk or No 3 catgut but this is usually not practical except in instances in which the scar has been entirely cut through or removed In cases in which large areas are simply denuded hæmostatic pressure with gauze is maintained as the denudation progresses When completed the grafts are sutured in place and the surface pressure reapplied The graft is put on to overlap the borders of the defect if more than one graft is needed the borders of each piece overlaps its neighbor This overlapping is possibly a prophylactic against future visible scar The grafts are held in place under about normal lateral tension by continuous basting or whipping stitches of horse hair (Fig 9) A graft that is put on under normal stretch will be clearer and less muddy looking than one that has been allowed to contract After the graft is sutured small holes are cut through it at appropriate intervals to insure drainage of blood and serum A retained blood clot may be a source of failure

#### DRESSINGS AND POSTOPERATIVE CARE

There has been more written on the dressings and postoperative care of skin grafts than on any other phase of the subject and in most of these contributions, many of which are a bit lengthy the factors that we have found best to promote a quick, sure take either are not mentioned or are not recommended These factors are (1)

absence of virulent infection (2) fixation, (3) pressure, and (4) provision for drainage

Fixation and pressure can be obtained with any good ordinary well applied surgical dressing Early slipping of the dressing may dislodge the graft This is one reason why we suture the graft and why we are liberal in our use of adhesive plaster on the dressing Any little secretion drying at the edge of the graft may block drainage or cause a dry dressing to stick and thus possibly detach the graft when the dressing is removed Therefore two layers of vaselined gauze are applied next to the graft under the pad and

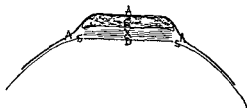


Fig 14 Dressing of donor area Diagram of cross section of leg to show dressing of an area from which a graft has been removed Note that the greased and the dry gauze barely lap over the edge of the defect and that the adhesive comes right up to the defect This is important to insure the stability of the dressing necessary for comfort This part of the dressing is not changed for 9 days unless necessary Over this dressing a larger absorbent one is placed and can be changed as often as desired A, adhesive G gauze pad X six layers of xeroform vaseline gauze S uncut skin D raw surface



Fig 11 Contracted eye socket grafted. A Girl of 21 years. The eye was removed 6 years previously for some sort of tumor or possibly a severe trachoma. The socket is so contracted that an artificial eye cannot be gotten in. B Six weeks after the orbit was grafted with split grafts.

put in place over two wax forms. artificial eye in place and easily removed and introduced by the patient. C The two wax forms that were put in the orbit carrying the split grafts for the lining. They were removed on the fifth post operative day. Patient referred by Dr L T Post.

area is healed. In an indolent ulcer or an old granulating surface all but the deepest layers of the mature scar base can be excised to advantage and either a graft applied immediately or a new, more healthy crop of granulations raised (Fig 4).

The selection of the source, the cutting, the application and the dressing of the graft and of the area furnishing the graft are all of importance and each should receive careful attention.

*Source of the graft.* The skin from which the graft is taken should be free from inflammation and it should be remembered that a graft of the thickness under consideration is apt to raise hair if it is taken from a hair bearing area. Such a development may

be objectionable especially for grafts put in the mouth. We have not a few patients who have to cut hair from these grafts. This surgery usually contemplates the improvement in appearance as well as in function, therefore visible mutilations should be avoided if possible especially in girls and girl babies. Today the areas of skin ordinarily exposed are somewhat less restricted than formerly and this is especially true in athletes, so that now the areas left from which grafts may be taken are the inner and outer surfaces of the upper half or two thirds of the thigh, the lateral surface of the buttock and the front of the abdomen. In babies still in diapers the abdomen is the site of choice (Fig 5).

*The cutting of the graft.* When possible the graft is cut large enough to cover the area and to extend beyond its edges. Even if it requires more than one graft it is desirable to have as few as possible and to have them of even thickness. On a large thigh with a fair amount of subcutaneous fat especially in women good sized grafts of fairly even thickness can be cut with a long light razor ground knife the skin being held tense and flat by traction pressure of small straight edged pans above and below the knife (Fig 6). In thin muscular men in thin patients with flabby muscles and on the abdomen especially of babies pressure methods to tighten the skin are not satisfactory. In such patients a suction retractor is almost necessary to secure the type of graft that is desired. It is helpful in any case (Figs 7 and 8).



Fig 12 Release of intra oral scar by thick split graft. A left. The lip is pulled up more by scarring in buccal fornix than by the external scar, the nasolabial sulcus is obliterated. B Restoration of lip to normal length by excision of the external scar and release from the fornix scarring with a medium thick graft sewed in place over a wax form in the fornix. The nasolabial sulcus has been restored being deeply released and the resultant raw surfaces covered with a graft over a fold of gauze. Patient referred by Dr G J Mautz.

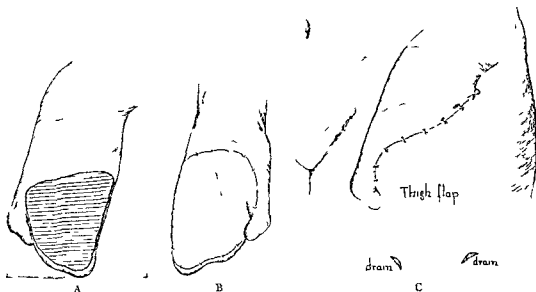


Fig 17 Grafting of the thigh defect simultaneous with the planting of the hand in the skin pocket A Clubbing of hand following burn The dorsal surface has been freed of scar preparatory to planting it in a thigh pocket for obtaining a suitable covering B Thick split graft sewed raw surface out on the palm of the hand When the hand carrying the thigh flap on its dorsal surface is removed this split graft will be found attached to the thigh C Diagram of hand in thigh pocket D Fair take of the graft at least enough to make complete closure of the defect possible This split graft thus applied to fresh clean raw surfaces except on such firm surfaces as the dorsum of the hand forehead etc does not give as high a percentage of takes as when applied to the scar base of a decorticated granulated or healed scar surface Nevertheless the plan is useful

pressure bandage In our original studies on the application of pressure dressings to skin grafts the use of sponge rubber inflated toy balloons lambs wool and damp marine sponges were included In our experience we have found that the moist marine sponge has been the most practical distributor of pressure (12)

On a well prepared healthy surface the first dressing should be the last but it is just as well to examine the wound at the end of 4 or 5 days or earlier if one has any doubt as to the healing quality of the grafted base In some instances the dressing is allowed to remain 10 days before it is disturbed Should a clot be found the overlying graft is split with a sharp knife or scissors and the clots peeled out then if the graft is clean there is fair probability that it will reunite to the base Should there be an accumulation of serous secretion yellow or clear the detached part of the graft is cut away with sharp scissors and the area is considered not clean and is dressed accordingly In such cases treatment consists in the application of an absorbent dressing very similar to the one used in the preparation of the granulation bed at least daily inspection of the area



Fig 17D

and the removal with sharp fine curved scissors of all raised edges of graft If after a day or two it is found that there is still a tendency for fluid to collect under the graft or to undermine the edges then the graft still considered unclean is protected by narrow three-eighths or one half inch wide adhesive strips which span the area and adhere to the skin beyond on each side These are placed one sixteenth inch apart to provide for drainage Over



Fig 15 Deep burn grafted in the fifth week. This patient was overturned in a farm tractor and the exhaust pipe pinned him down across the left flank. He remained there for an hour and three quarters. The frame of the tractor rested across the inside of the right thigh just above the knee and divided the tissues subcutaneously almost down to the femur the skin remaining intact. When seen a few hours later a burned mass of skin and subcutaneous fat covered the whole flank and extended down over the ilium. A débridement was begun but because the exact plane of demarcation was not evident and because it would probably be necessary to expose a good deal of the ilium the process was carried out over the upper half only. The burn was approximately 4 centimeters thick. Mildly antiseptic picks were used. The sloughs were soon free and healthy granulations were obtained in the half of the area that was not excised about as soon as in the other half. Thick grafts some of them 4 inches wide were cut with the aid of the suction retractor from the left thigh and were sewed in place after the granulations were cut away down to a scar base. A small area of bare bone remained on the iliac crest. The grafts were applied to within one half inch of bare bone in spite of a slight discharge as well as over the whole wound. The photograph shows the full take of the grafts even down to the exposed edge of the bone. Healing was complete in 14 days except over the exposed bone. No attempt was made to debride the dead bone and the patient was sent home to wait for spontaneous separation or possibly complete healing over it. This illustrates an economical advantage in the early grafting of burns. In 5 weeks after the accident the whole area was grafted and as far as the grafts were concerned he could have gone to work 3 weeks later but in spite of the wound mentioned he was doing work as an overseer in one month. Though 4 to 5 centimeters of tissue was burned restoration was satisfactorily made with thick split grafts. In this instance the thickness of the tissue destroyed happened to be fat deposit.

because xeroform is supposed to be antagonistic to staphylococci which are present in all skin and all grafts, we make up the vaseline with 3 per cent xeroform. On a firm, even surface where pressure is easily applied such as the forehead we may use only dry gauze sponges next to the greased gauze. On uneven surfaces on surfaces that lack a firm foundation such as the front of the neck, or on the

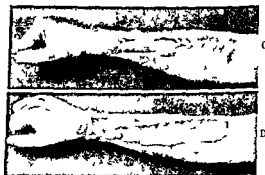


Fig 16 Electric burn scars relaxation by decortication grafted. A Man aged 31 years was admitted to the hospital 5 months after he had suffered a severe electrical shock and burn. Healing had occurred but a very thick (1.5 cm) keratosis in the inguinal region had formed. The contraction pulled the scrotum over toward the groin the tissues all around the area were drawn and uncomfortable. The arm was covered with thin epithelium that broke open on the slightest injury. The hand and forearm movements were handicapped. The use of a flap or of a full thickness graft of adequate size would have been but shifting the location of the defect and also time consuming. B The groin 9 weeks later. Note that the scrotum is free also the comparative size of the scar area and the grafted area. The patient volunteered the statement that the grafted area was practically the same size as the original burned area. Complete subjective relief was obtained. On account of a thrombosis in the opposite leg that occurred during the healing of the burns the patient did not go back to work as an electrical lineman until 4 months after the operation though as far as the grafted area was concerned he could have gone to work in a month. C D Arm grafted at the same time as operation on groin. total operative time 1 hour 55 minutes. Excellent example of extensive repair that may be made at one sitting by utilizing this type of graft. Patient referred by Dr F D Sultzman.

hand, large flat damp marine sponges which do not touch the bare skin are applied evenly over the gauze pads. The whole dressing is fixed by a

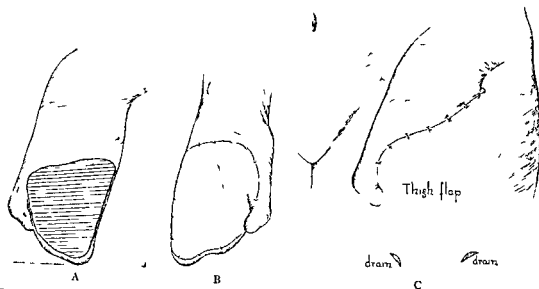


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Fig 18 Combination of full thickness and thick split graft. A left Boy 17 years of age 2 $\frac{1}{2}$  years after being burned and after having received some X ray or radium treatment elsewhere for the scarring. There is loss of the normal contour of the neck and ectropion on one side of the lower lip. B Restoration of lip contour 2 weeks after operation with a thick split graft sutured to the surface of the chin and cheek and one applied over a curved wax form on the defect of the lip. The neck scar has been dissected out and the defect covered with a full thickness graft. Patient referred by Drs. Biering Lynch and Rice.



Fig 19 Burn scar (frost bite local tuberculosis). A Scar over whole face from a burn 19 years before. Frostbite of the area 10 years later had resulted in further trouble with pain ulceration and ectropion. There is a complete ectropion of the left lower lid and a shortening of the upper. The ear is adherent to the skull. Microscopic examination confirmed the diagnosis of tuberculosis of the skin. B At most total restoration of the surface of the cheek, outer surface of the ear and mastoid region, with one large thick split graft. The lower lid ectropion has also been relieved with a similar graft put in over a wax form. Note that the

large graft has a wrinkled appearance due to a slight contraction of the bed scar. But this later relaxes (see C). Following the restoration of the cheek and eyelid the patient worked through the winter out of doors in comfort for the first time since the burn. C Eleven months later shortly after new grafts had been put on the nose outlined with mercuriochrome upper lip and over the orbital ridge. The ear has been released from the scalp by a graft put behind it over a form. The large cheek graft has lost its wrinkled appearance and is perfectly smooth except at the anterior edges. It has become deeply pigmented.



Fig 20 Portwine stain <sup>1</sup> radiation subsequent scarring A, left Girl aged 9 years with scar of radium burn following treatment for an angoma at 6 months of age The surface was excised down to a very thin smooth scar base going into the underlying fat in one place One large fairly thick split graft was taken from the upper part of the thigh with the aid of the suction retractor sewed in place and dressed with sponge pressure B The full take and complete healing 18 days after the operation



Fig 21 Scar following radium treatment grafted A left Woman of 26 years with telangiectasis of 10 years duration following radium treatment for goiter There was apparently not much activity but the scar was unsightly The area was excised and a graft put on B The graft 8 days after operation

this is placed the damp drainage dressing The latter is changed sufficiently often but the adhesive strips which prevent trauma to the grafts are left unchanged as long as a week if they do not become loose Fortunately special treatments of this kind are rarely necessary

In certain sites such as within the mouth on the eyelid and on the lip it is not practicable to obtain pressure by ordinary dressings In these situations if the graft is wrapped around a wax form raw surface out lateral tension of the graft is obtained by the friction of the graft on the wax or by the suturing under tension of the graft over the wax In turn the tissues to be grafted are sutured under tension

Two instances are taken care of by excision of the surface which does not vary in the depth of the excision and with the application of large split grafts Specific instances are omitted here because a separate paper on this subject is in preparation

around the graft covered form which furnishes the desired pressure Such grafts properly implanted in a newly made wound in the mouth will if the patient is in fair condition and not subject to any acute infection heal in close to 100 per cent of the cases in spite of the fact that the graft and the wound have been bathed in saliva (3) (Figs 10-11-12-13)

On two occasions the wax form of an eyelid graft was removed on the second day on account of discomfort in the eye—a complaint which should never be disregarded The graft was lost in neither of these cases After removal of the form the grafts are treated by the simple application of a thick layer of vaseline which will prevent formation of crusts at the newly healed borders—another form of drainage

The names of Esser Gallies and Wall on a case associated with the wax method of development of the plan of applying the graft



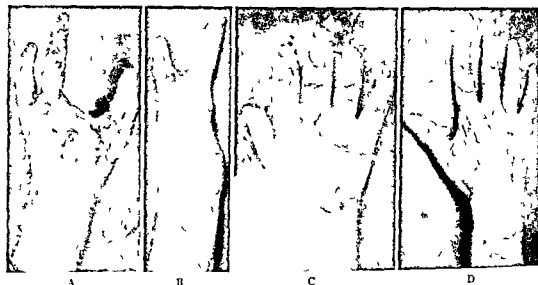


Fig 22 X ray burn scars keratosis carcinoma A The hand of a physician an early worker with X ray. The two fingers had already been amputated because of extreme change and at the base of the thumb definite low grade squamous cell carcinoma had developed. Amputation above the wrist was advised but because of the necessity of some part of a hand for his work another plan of treatment was followed. Half of the hand was amputated the cover was removed from the dorsum of the two remaining fingers

and an abdominal flap was put in place. B The hand 30 months after the rest of the covering has been removed and replaced by a thick split graft. The free graft limits are within the dotted lines. C The other hand 1 week after a number of its keratotic areas had been excised at one operation and replaced with these grafts. D The same hand 20 months later and the smoothing out of the grafts that occurred without further operation. Patient referred by Dr. C. S. Venable.



Fig 23

Fig 23 Old roentgen ray burns excised grafted. Woman of about 55 years treated with X ray 14 years ago for fibroids. The skin looked red and leathery for 8 years. Ulcerations then occurred and were present for 6 years. She was treated with Quartz light and during this treatment became worse. Examination showed involvement from just above the pubis almost to the umbilicus 12 to 15 centimeters wide on each side. There was telangiectasis, scarring, keratosis and ulceration. At operation a wide deep excision was done. There were places where the aponeurosis couldn't be identified and there was a question whether malignant change had taken place. (Malignancy was not found on microscopic examination.) The resultant raw surface was not a real satisfactory surface for any kind of free graft and while it was appreciated that grafts applied might not all grow with this type of graft there is little lost in trying. Two large grafts were cut with the aid of the suction retractor sewed in place and firmly dressed with sponge pressure. The largest of these grafts was 25 centimeters long 15 centimeters wide on one end and 10 centimeters on the other after they were on the abdomen. There was about 30 per cent loss of these grafts. Seven weeks later at the time of a second operation the raw area had contracted so that the defect was about one-fourth the size of the original. Split grafts were put in place in three sections after cutting off the granulations. Healing was complete in 7 weeks. The patient is shown here 3 months after the second operation. She is free of subjective sensations and no ulceration or other signs of activity are present. Patient referred by Dr. E. Jonas.

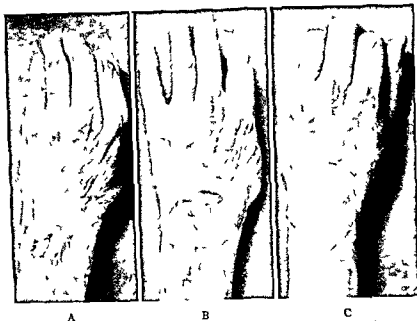


Fig. 24. Primary skin cancer complicated by radium burn. Ulcer had persisted 15 months. Flexion of the wrist and fingers was limited by the contraction. The ulcer including the whole scarred area was excised down to the deep fascia which apparently was not involved and immediately grafted. B. Roughening of the area that occurred in the first few months after grafting. C. Result 16 months later with full flexion possible and 100 per cent function. Note that the graft has stretched and that the junction with the surrounding skin can hardly be made out.

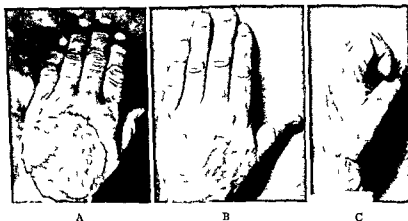


Fig. 25. Restoration of covering of dorsum of hand. A dentist aged 41 years lost most of the skin of the dorsum of the hand in an automobile accident. The tendons were exposed and torn but none was severed completely. When admitted to the hospital the wound was covered with clean granulations and movement was hindered considerably. In this instance the granulations were cut off down to a yellow scar base and two thick split grafts were used to cover the defect. The grafts were put on as a surgical dressing to get the wound clean enough so that a thicker pad either a full thickness graft or a flap could be transplanted. A. The graft 4 months after the operation. Function was good and the patient was able to attend to his dental practice with so little inconvenience that he did not return for further work. B and C show the hand after about 2 years. Note the normal looking wrinkling of the skin. The wrist cannot be fully flexed because of tightness of the extensor tendons and not because of lack of skin covering. Patient referred by Dr. C. H. Jameson.

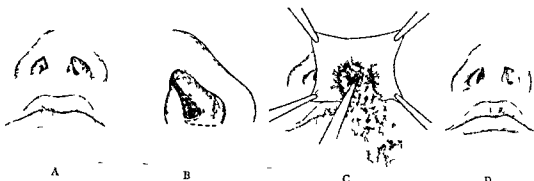


Fig 26 Restoration of nasal passage after almost complete atresia from scar contraction in the vestibule. A Original condition of left nostril which is obstructed by a scar contraction at the junction of the vestibule with the nasal cavity. B Incision along the border of the impinging fold of the vestibule lining continued across the floor of the vestibule to the border of the ala (indicated by the heavy dashed line). The transverse line of light dashes above indicates a part of this incision that is hidden within the nostril. The outlined trap-door is dissected forward with its base toward the alar border and from behind it is re-

moved enough scar and fibrous tissue to give a very much expanded vestibule. The stippling indicates the extent of the excavating. The trap-door is dropped back into place and a large split graft is put in in the form of a Mikulicz pack with a strip of moistened fine silk marne sponge as the core. The pack is kept from slipping by one horse hair suture from the ala to the columella. D Diagram of final result in a case operated on. The nostril has remained open and functioning for 5 years. In bringing a contractile cavity with a split graft allowance should always be made for contraction.

The graft and the conjunctival sac should receive daily attention. Great care should be exercised in the removal of the wax forms. With a sharp knife or scissors a cut should be made carefully through all stitches and the excess graft overlying the outer surface of the form and this process continued until the form itself can be plainly seen. Then separation to each side is carefully accomplished, and with the aid of soaking if necessary the form may be loosened from the graft and lifted from its bed. The dead edges of the graft can then be trimmed and the cut sutures removed.

*Dressing of the donor area.* Discomfort in the area from which the graft has been taken may be caused by one of two factors: (1) infection which might

rarely occur from organisms liberated from sweat and sebaceous glands at the time the graft is cut (2) movement or pulling of the dressing. Ordinarily these areas are made comfortable by immediately applying six smooth flat layers of vaseline xeroform gauze covered with a flat gauze pad neither the gauze pad nor the greased gauze extending more than  $\frac{1}{4}$  inch beyond the raw area. The whole is then firmly strapped in place by means of adhesive plaster which prevents any sliding or pulling on the raw surface of this deep dressing (Fig 14). Over this is bandaged a protective absorbent pad which may be changed as it becomes soiled. If two parallel grafts are taken from the thigh a strip of uncut skin is left between the defects for the attachment of adhesive plaster. Ordinarily at the end of 9 days the blood soaked original dressing is lifted off or it is soaked loose by a wet pack. If the graft has not been cut too deep the whole area is usually found to be healed. If in any place the cutting has gone down to the fat healing at such spots will be delayed. If the patient walks about at this time it is well to reapply a firm pressure dressing under adhesive plaster to try to prevent the possible formation of small hematomata under the fresh thin epithelium. If it becomes uncomfortable before the ninth day the dressing is soaked loose and the area redressed with the greased gauze. If infection occurs damp pressure dressings are used.



Fig 27 Total restoration of the skin of the forehead. The forehead tissue was used for a lip reconstruction and the forehead covered with a single large thick split graft put right on the periosteum. Note that the graft edge has come to the same level as the skin of the scalp. The graft has also become quite movable. Patient referred by Dr. A. B. Kanavel.

#### TREATMENT OF DEEP BURNS

Willis (4) and others have treated burns by immediate excision down to the sound tissue and then grafting the raw area, if necessary, when the wound has become sufficiently clean. In cases in

which this can be successfully accomplished it is of real advantage. Regardless of the will to do so, in many cases whether from the extent of the burn, the condition of the patient, or the controlling circumstances such treatment is at present impracticable. This should not, however, make one content with a practice all too prevalent of allowing these wounds to become deeply infected and to granulate and suppurate for months and possibly years before the wounds are covered with hard, distorting, limiting scars which without later help, cripple the victim throughout life and later are too often the site of cancer. Figs 4-15-16-17-17-19.) Most joints so fixed by scar can be released by means of flaps or full thickness grafts. This is not true, however, of the fingers which during the slow healing process of a burn extending little deeper than the skin, often become so fixed by penarticular thickening that a year or more of manipulation may be necessary to release them or they may never become released.

Immediately after the calamity of an extensive burn relief of pain and preservation of life are the all embracing considerations, but as early as possible means should be taken to protect the wounds from infection and to encourage drainage. The so called open treatment of burns, which too often means a pus poultice under crusts may be sufficient for superficial burns, but our observation of the late results of such treatment of deep burns makes us feel strongly that whenever possible some other plan of treatment should be instituted especially when the full thickness of the derma is destroyed. When we have treated fresh burns we have usually been able to secure a healthy, firm, granulating surface within a month and have the grafts healed in place within 2 weeks more (Fig 15).

We have the most profound respect for the skill and devotion of the man who brings one of these badly burned children through alive, and we see many on whom the scarred area is so extensive that it probably would not have been practicable to have covered the early wound completely with grafts. Here the judicious use of the small deep graft as described by Davis should greatly shorten the convalescence and might be all that would be necessary. In spite of many literary citations to the contrary all our experiments with homo grafts have ended in the graft being completely absorbed in from 3 to 6 weeks after it had healed in place even when the bloods matched. Our observations however are incomplete as we have never tried the application of grafts from one young child to another of similar age

nor have we grafted from one identical twin to another.

*Röntgen ray and radium burns* (5) In the treatment of radium and roentgen ray burns the object should be the complete removal of the involved tissue with an attempt to get beyond the limits of the endarteritis the telangiectasis and of the active keratosis. Upon the type or degree of burn present, the size and depth of the necessary excision and the location of the defect on the body, will rest the choice of method of repair. If free skin grafting seems indicated full thickness grafts or thick split grafts may be used.

In those burns evidenced by change in color, by telangiectasis and possibly by some slight scaliness the preparation of the bed for the graft may be done as in healed burn scars, by slicing off the surface down to a very thin layer of derma and then immediately grafting with thick split grafts. If, in these areas there are any smaller areas of excessive scaliness or keratosis the excision should go deep and the defect in the graft bed should be closed with sutures to try to preserve smoothness if it is desired. Though trouble might possibly develop later in these areas so far we have not had any. If it should occur deeper excision and regrafting should be done (Figs 20-21).

Burns in which active keratosis is present should be widely excised to their full depth, though the determination of their extent may be difficult. If free grafting is indicated the thick split graft will be appropriate in many instances (Figs 22-23).

#### LARGE FACE AND NECK BLEMISHES

We have treated large areas of damage to the skin of the face and neck especially in women, such as oil or dirt filled superficial abrasions, large naevi or hairy moles and scars resulting from trauma, acid or radiation by dissecting off the lesion or scar down to the subcutaneous tissue and then, after allowing the area to granulate for 3 weeks, applying a thick split graft as described under burns. If the scar is in the form of plaques in or under the derma, as has occurred from long severe acne or smallpox great improvement has resulted from dissecting off the damaged skin and the bases of the pits and applying the graft to a deeper plane of this blanket scar.

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PALINGENESIS OF VISCERA<sup>1</sup>

J. CHRISTOPHER O'DAY, M.D., F.A.C.S. HONOLULU, HAWAII

WHEN that closely observing French physician, Glénard, gave to the medical world the treatise on gastro-enteroptosis that immortalized his name, it was with no thought that the disease would ever become a surgical one. 'For successful treatment,' he says, 'the following must be carried out: (1) the intestines must be raised and maintained in their position; (2) the abdominal tension must be increased; (3) the bowels must be regulated; (4) the secretions of the digestive tract and of the annexed glands must be stimulated; (5) the alimentation must be regulated and the digestion assisted; and (6) the organism must be stimulated.'

Speaking of Glénard's work in relation to gastroptosis and enteroptosis, Finhorn has this to say: 'The idea which led the French physician to the discovery of the disease designated by his name (Glénard's disease) was the fact that the whole digestive tract, which from the mouth to the anus is ten or fifteen times longer than a straight line connecting both points, is arranged in the form of different baldachins suspended on six loops by means of ligaments at the posterior wall of the abdomen. The zigzag direction of the loops offers the possibility of too great a bend, sometimes at such an acute angle that it causes obstruction to the passage of the ingesta or secretions at the six main points of fixation.'

The light the years intervening between Glénard's time and now have thrown on this subject has not changed one of those six main points.

Ptosia of the abdominal viscera which has progressed to a degree capable of producing kinks of occlusion particularly in the duodenum, will cause discomforts that may be difficult to differentiate from those caused by peptic ulcer or gall bladder disease. On the other hand similar occlusions at the lower ileum or cæcum may in effect simulate any one of the various appendiceal disturbances. This is a point that will bear emphasizing for it is true that many an able and conservative abdominal surgeon has been tricked into performing gastrojejunostomies or appendectomies that failing to give the expected relief have made a repentant of one who unwittingly neglected to consider the likelihood of the presence of a gastro-enteroptosis. Indeed we must not forget that gastro-enteroptosis is a characteristic affliction in a certain type of individual

Moynihan says, 'The patient is almost always a neurasthenic of a most pronounced type.'

This statement is true as far as it goes; the danger lies in the inference that the neurasthenia is the cause of the ptosis. In my opinion judgment from the work of Coffey and from my own experiences many cases of extreme visceroptosis give rise to that syndrome of complaints which out of a better understanding we classify as *neurasthenia*, and yet once a correction of gastrointestinal function has been accomplished and the neurasthenic no longer complains, our belief in the neurasthenic cause of ptosis becomes less secure. In fact, we cannot ignore the numbers of neurasthenics who have no digestive disturbance at all. It is best not to try to associate a purely mechanical disease with any temperamental type of individual. But there is a type we must not ignore if we wish to be on the alert; ptosis of the abdominal viscera belongs only to the slum jims.

The first requisite of Glénard's treatment was to raise the intestines and then maintain them in the raised position. To accomplish this he used a pad. The pad was worn in such a manner that pressure was exerted on the lower abdomen. Nowhere is he enthusiastic about the ultimate results of this treatment. The principle is correct. Correction, however, can be properly accomplished only by careful surgery. Without it palingenesis of visceroptosis is impossible.

When the abdomen has been opened in the belief that peptic ulcer, gall bladder or appendiceal disease will be encountered and we find no such condition the sting of our humiliation will be lessened if due regard has been given to the type and the likelihood of existing prolapse. With a well-defined set of plans that can be relied on to determine and correct an existing visceroptosis we may proceed with the operation without the betrayal of that awkwardness inevitable in single tracked attitudes.

Before an intelligent or clear conception of gastro-enteroptosis can be derived it will be necessary to have become familiar with the embryological development of the peritoneum. We learn then how the duodenum became fixed in a peritoneal tunnel that has its termination to the left of the vertebra and from which it emerges to join the freely mobile jejunum.

The stomach may occupy a position much lower than that which we have been wont to

<sup>1</sup> Read before the Oregon State Medical Society, LeGrande, Ore., May 16-18, 1910.

regard as normal and not cause distress. However, if it is low enough to interfere with its own motility where should we look for the evidence of that interference? At the entrance of the tunnel. There the drag of the prolapsed stomach has produced a kink, and we find a dilated proximal stomach and a collapsed distal duodenum. The gastrohepatic ligament is no longer capable of supporting the stomach.

Let us assume that instead of observing a dilated stomach in association with an occlusion of the upper duodenum we find that both stomach and duodenum have undergone a marked dilatation. Where, then, should we look for the obstructing kink? Picking up the jejunum just distal to the duodenojejunal junction and finding it normally patent we are warranted in concluding that the occlusion is caused either by a tightening of the superior mesenteric vessels in their transit over the lower portion of the duodenum or else by a kinking at the margin of the outlet of the tunnel—the latter being of most infrequent occurrence.

The mesenteric root crosses the vertebra from upper left to lower right. If it is given a downward pull, by reason of this position, it falls toward the left flank. When we find the mesenteric root in the left flank, a survey of its fat is taken. If there is a goodly leaf of fat between its folds, we have the assurance that the lacteals are imposing no hindrance on the free passage of the chyle to the thoracic duct. On the other hand, should it have lost its fat and come to resemble tissue paper with blood vessels sprawling over its threatening thinness, the conclusion is justifiable that such a degree of starvation could not obtain under any conditions other than partial occlusion of the lacteals themselves.

With hepatic and splenic flexures intact ptosis of the transverse colon cannot reach a degree extreme enough to produce any symptoms whatsoever. The point to be determined relates to the two interdependent ligaments, i.e. the gastrohepatic and the gastrocolic. When for the need of the support of the gastrohepatic ligament the stomach has gone down with the transverse colon the drop, if low enough, can kink the duodenum at the entrance of its tunnel.

It should be kept in mind that unless the gastrohepatic ligament becomes inadequate kinking at the entrance of the tunnel cannot obtain. And further it must be remembered that the gastrohepatic ligament, whether adequate or inadequate, has no part in the production of occlusions of the lower duodenum. Such obstructions can come only from a drag on the mesenteric

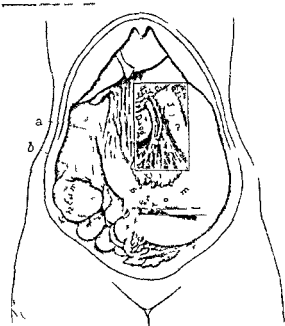


Fig. 1. *a* Drag and kinking on upper portion of duodenum. *b* ptosis of ascending colon producing twist at ileocecal junction. Insert *A* shows the superior mesenteric vessels as they emerge from pancreas to cross over lower portion of duodenum.

root which either obstructs by kinking at the jejunal beginning or else by tightening the superior mesenteric vessels over the last portion of the duodenum. These obstructions can be relieved only by a posterior, no-loop gastrojejunostomy.

Ptosis of the transverse colon alone, meaning that the gastrocolic ligament has become over stretched between stomach and colon, need not be regarded seriously. But when the ascending colon and cæcum are mobile and the ascending colon has gone down with its transverse fellow, inspection of the ileocecal junction will reveal a twist that not only inhibits passage into the colon but diverts the stream so directly into the cæcal pouch that dilatation, made worse by stasis, converts the caput coli into a very mischievous cesspool.

There is another sequela of visceroptosis not to be overlooked—interference with the return of the venous blood—which is recognized by either a general or local cyanosis. Viscerocyanosis associated with lower duodenal occlusion speaks the extent to which the drag has impinged upon the superior mesenteric vein. In cases in which the cyanosis creates a zone immediate to the

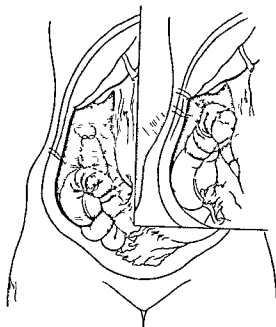


Fig 2 Suture of ascending colon to posterior parietal peritoneum

point of occlusion it can be readily recalled that undue pain and tenderness were pre operative indications

In one of my earlier articles<sup>1</sup> I made a distinction between ptosis, stasis and inertia. The distinction should not have included stasis beyond that it is a mere symptom that belongs to each of the other two conditions

It is when we subject this symptom as it is related to these two visceral inhibitions to a careful scrutiny that it immediately becomes apparent how the two may be confused. But the treatment of each being so diametrically opposed neglect of differentiating can ill afford to be countenanced. Ptosis is a mechanical interference of function, inertia is a paralytic interference of the same function. Ptosis exerts its baneful effect by causing partial strangulations at given points. Its treatment is therefore mechanical.

When the venous circulation becomes involved it would not be unreasonable to assume that the portal function of the liver becomes to a degree, somewhat affected. This of course, is conjectural, yet the subnormal temperature so fre-

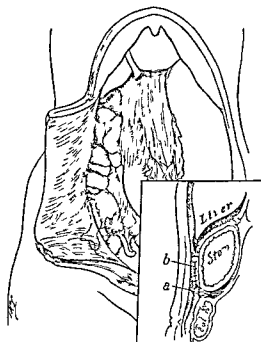


Fig 3 Suture of ascending colon to lateral parietal peritoneum. a Plication of gastrosplenic ligament b anterior and lower portion of stomach sutured to falciform ligament and reflection of peritoneum

quently observed accompanying the condition would suggest such a possibility.

With inertia no points of kinking or constriction are to be found the stasis is general, the transit of bowel content is slow in consequence of a sluggish peristalsis. Obviously pain cannot be considered in the presence of inertia.

With ptosis there will be not only cramp like and colic like pains but as well a point of tenderness over each stenosed portion of the gut. We must remember that precisely the same principle holds good as in making a differential diagnosis between gastric atony and pyloric occlusion. In both of these inhibitions the contents of the stomach are long retained but in atony there is no pain. The stomach is inert. With pyloric occlusion the stomach still possesses its motive power and each contraction produces a pain commensurate with whatever degree of pyloric narrowing has obtained.

Another point to be emphasized is the uncertainty of roentgenograms. Indeed no roentgenogram can be properly interpreted unless the type of the individual is first considered, for all long waisted, flat bellied people give pictures

<sup>1</sup>The later history of stasis, ptosis, and inertia of the intestinal tract. *Ann Surg* 1918 July

that greatly resemble ptosis whether or not stasis exists. Again, the picture reveals those peculiar separations and accumulations of barium so easily mistaken for occlusions that unless the importance of pain, as the paramount means of differentiating, be included grave doubts and uncertainties may befall what should really have been a clear and concise diagnosis.

Let me qualify this last statement. By a clear and concise diagnosis I do not mean that diagnosis should be absolute but rather that a conclusion be reached wherein we are assured that surgery is imperative. Then, when the abdomen is opened, we may be saved the humiliation of having made a useless incision.

In the absence of pathological conditions in the stomach, duodenum, gall bladder or appendix it will be forcibly brought to mind that the undue droopings of the viscera as noted in the roentgenograms have carried these organs far enough beyond the range of their natural supports to have produced the acute angles necessary to cause occlusion.

At this juncture we must seek the vulnerable points. Beginning with the gastrohepatic ligament direct inspection of this support is not necessary. Instead traction is made on the stomach and held to the limit of the downward pull until it is ascertained whether the check comes on the duodenum. If it does, the kinking over the margin of the duodenal tunnel is immediately brought into view. Beginning thus the inspection is most aptly carried out in the following order: adequacy of gastrohepatic ligament by traction on stomach, upper and lower duodenum, duodenojejunal junction—gastrocolic ligament, root of mesentery, mobility of ascending colon and cæcum.

While there comes an assurance to reward one for the making of this survey, it is well to have in mind the disaster that is so very likely to follow any attempt to deal directly with constricted or flattened out blood vessels (veins). If the viscera are rehabilitated to whatever degree their environments will permit the veins will take care of themselves.

Enteroptosis is too frequently associated with gastropnoxis to permit the correcting of one without having ascertained the possible presence of the other. This is a phase of visceroptosis that textbooks have failed to emphasize. Indeed, gastropnoxis should never be considered separately. So seldom is it the sole trouble that no matter whether the operation of Coffey, Duret, Rossing or Beyer has been employed no good will come of it.

There is another thing well worth having in mind. It is this, *ptosis that produces occlusion of the lower duodenum by traction on the superior mesenteric vessels is a ptosis that had its origin in a congenitally made movable ascending colon and cæcum*. We need but glance at a ptosed ascending colon where it has kinked over the meso-ileum to understand just how traction is ultimately transmitted to these vessels. Robert C. Coffey, in his classical treatise of enteroptosis traces the cause of movable ascending colon and cæcum to an embryological inability of the peritoneum to become fused into the needed layers of support. Coffey's experimental work proved this to be the key to the entire problem of enteroptosis.

This is the reason I have used the word palingenesis. By means of surgery we are going to give to a set of misplaced viscera their normal positions of which they have been deprived through some trick of nature during embryological development—an artificial rebirth, as it were.

#### TREATMENT

The pocketing of the caput coli beneath the posterior parietal peritoneum lacks surgical appeal, nor does it seem necessary. With the appendix present, enucleation from out its serosa leaves a well salvaged meso-appendix that can be shelved into an equally secure support. It is not always possible to re-instate the ascending colon to the site originally destined for the hepatic flexure. However, when we set to work to fuse the peritoneum into those ligamentous supports that by some trick of nature have been deprived of their embryological rights it must not be forgotten that immobilization of the ascending colon to a point high enough to protect the ileocecal junction from a recurrence of the kinking is the thing that must be accomplished. It is the only means of relieving the drag on the meso-ileum which, in turn, becomes transmitted to the root of the mesentery.

To facilitate the work of immobilizing the ascending colon, its transverse fellow, the great omentum, is drawn upward and out of the peritoneal cavity. The small intestines are then introduced to the left and held there by properly adjusted gauze packs. A curved intestinal needle, armed with either fine chromic gut or linen, picks up several bites (no less than three) of the posterior parietal peritoneum, passes to the colon, and takes from below upward a similar number of seromuscular bites (Fig. 2). If these stitches are carried interruptedly as high as it is possible to go toward the site of the hepatic flexure their tying will bring into apposition two



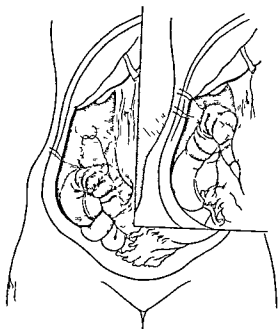


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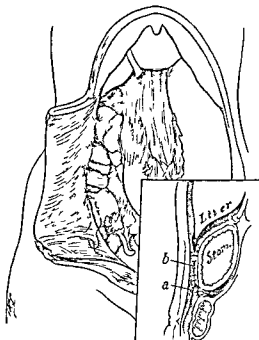


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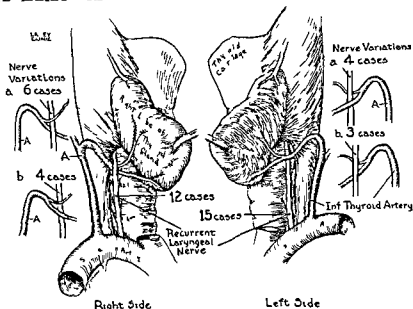


Fig 1 Relationship between the recurrent laryngeal nerve and inferior thyroid artery with variations on both right and left sides in a series of 22 neck dissections

left sides The observations made were as follows

*On the right side* In 18 out of 22 dissections, the nerve was anterior to the artery, and in this group, 6 appeared anterior only to the lower larger terminal branch of the artery and posterior to the upper ascending division. In the remaining 4 dissections the artery was anterior to the nerve and in very close contact with it (Fig 1)

*On the left side* The artery was demonstrated anterior to the nerve in 19 dissections, and in this group, the nerve passed between the terminal branches of the artery 4 times coursing posterior to the lower branch and anterior to the upper division of the vessel. In the remaining three dissections the nerve was anterior to the artery (Fig 1)

As to the relative position of the recurrent nerves on the trachea, it was observed that they both run in the tracheo-oesophageal sulcus, with the left more often appearing a little deeper in the sulcus than the right but it cannot be said that the right lies more anteriorly on the trachea than does the left as stated by Dilworth

Dr Berlin's dissections demonstrate quite definitely the difference in relationship between the recurrent laryngeal nerve and the inferior thyroid artery on the right and on the left—something to be remembered in the ligation of the inferior thyroid artery—and the fact that a twig from the superior laryngeal nerve quite constantly supplies the interarytenoid muscle

At the suggestion of Dr Lahey, a series of 34 dissections were carried out to study and demonstrate 2 distinct anatomical entities

1 Twenty two dissections were made to show the relation between the inferior thyroid artery and the recurrent laryngeal nerve, comparison being made between both sides of the neck

2 Twelve human larynges were dissected for the purpose of demonstrating their nerve supply, particular attention being paid to the source of innervation of the interarytenoid muscle

With reference to the first group of dissections, it is notable that none of the classical textbooks in anatomy describe differences in the relationship of artery and nerve between right and left sides. The following quotations are from some of the authors

Gray 'The inferior thyroid artery divides into two branches at the lower border of the thyroid gland and the recurrent nerve passes upward generally behind the artery'

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The gauze pack is removed. The transverse colon and great omentum are restored to the abdominal cavity. The gastrocolic ligament is examined. If too long it is shortened by plication so that the transverse colon and the greater curvature of the stomach are brought together. While textbooks graphically describe methods of shortening the gastrohepatic ligament or omentum,

none of them has seemed feasible because such methods are so likely to endanger blood vessels. Rather than assume such a risk we have used the falciform ligament in conjunction with a reflection of the anterior parietal peritoneum. These are so fused to the anterior lower portion of the stomach that a horizontal plane is established and maintained between the upper portion of the duodenum and the stomach.

A mobile descending colon I have yet to encounter. This fact suggested the modification of Coffey's hammock operation. Instead of attaching the great omentum across entire width of abdomen I stop when enough hammock has been made to support well the stomach's lower third.

## DISSECTIONS OF THE RECURRENT AND SUPERIOR LARYNGEAL NERVES

THE RELATION OF THE RECURRENT TO THE INFERIOR THYROID ARTERY AND THE RELATION OF THE SUPERIOR TO ABDUCTOR PARALYSIS

DAVID D. BERLIN, M.D., AND FRANK H. LAHEY, M.D., F.A.C.S., BOSTON, MASSACHUSETTS

TO demonstrate in the anatomical laboratory what we had seen at the operating table, dissections of the recurrent and superior laryngeal nerves were made by Dr. Berlin. We hoped thus to determine (1) the difference in relationship between the recurrent laryngeal nerve and the inferior thyroid artery on the right and left sides and (2) the possibility that some of the fibers of the superior laryngeal nerve other than the branch to the cricothyroid muscle were motor in character, which would perhaps explain the fact that the vocal cords are held in close adduction at least late after severance of the recurrent laryngeal nerve. The truth of this latter statement was proved to us by the recent personal observation of a patient who was operated upon elsewhere for exophthalmic goiter and who came to us with a very definite bilateral abductor paralysis with both cords in marked adduction and with a very narrow glottic space. We operated upon this patient and found the right recurrent laryngeal nerve completely severed, thus demonstrating the fact that the vocal cord may be held in complete adduction even after the nerve (adductor fibers of the recurrent) supposedly supplying the adductor muscles of the cord is cut.

It has been demonstrated in animals that the recurrent laryngeal nerve contains two sets of

fibers, adductor and abductor, and that this nerve innervates the muscles of abduction and adduction of the vocal cords. In the case of the patient mentioned who came to us 3 years after a thyroid operation the cords were not relaxed in the cadaveric position following severance of the nerve (which was identified as such by laboratory examination) but were in complete adduction, demonstrating the fact that they must be held there by some motor innervation other than that of the recurrent laryngeal nerve. It is interesting to record that in our patient it was demonstrated that the recurrent laryngeal nerve was completely severed and the superior laryngeal nerve was cut at the point where it penetrated the thyrohyoid membrane, so that the possible motor innervation of the interarytenoid at least on one side was severed.

It is of further interest that following severance of the internal branch of the superior laryngeal nerve immediate observation showed no change in the position of the cords. The laryngologist reported that the only difference that could be noted from the pre-operative observation of the cords was that the right cord was perhaps narrower than the left.

In our group of dissections there was a significant variation in the findings between right and

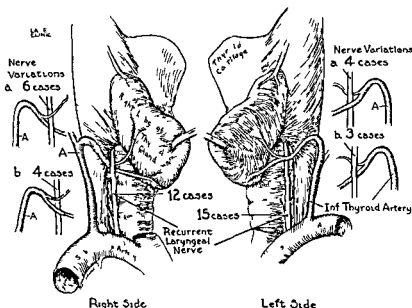


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## GONOCOCCUS ARTHRITIS—A STUDY OF SIX HUNDRED TEN CASES

HEINRICH L. WEHRBEIN, M.D. NEW YORK

From the Urological Department Bellevue Hospital

**A**THRITIS due to the gonococcus is a comparatively rare complication. It has been estimated that but 1 to 3 per cent of all gonococcus infections lead to the metastatic infection of one or more joints. Since gonorrhoea is more prevalent in metropolitan districts than elsewhere, in a city like New York, practitioners see a fair number of cases.

Gonococcus arthritis presents difficult problems both for the patient and for his physician. The patient suffers great pain and the disability usually lasts a comparatively long time.

Aside from the presence of the gonococcus, little or nothing is known about the various factors which are responsible for gonococcus arthritis. Constitutional factors may be responsible to some extent but this has not as yet been demonstrated. Neither has it been shown that previous non-specific joint infections predispose toward gonococcus infections of the joints. The often quoted observation, however, that a patient who has suffered from gonococcus arthritis is more likely to develop metastatic joint lesions during a subsequent gonorrhoeal infection, can be proved. The frequent history of trauma has led many observers to the assumption that trauma is one of the major contributory factors. Pathological considerations, namely the metastatic origin of joint lesions and the great frequency of multiple joint infections, make it appear that trauma can not be anything but a minor contributory factor.

The clinical picture is fairly simple. The majority of patients present one or more joints which are swollen and painful. Active and passive motions are usually impossible during the early days and the pain may even be so great that sleep is impossible. The temperature is moderately raised and the patient may or may not have additional urological complaints, as urethral discharge, dysuria or nocturia. No age seems to be exempt. The incubation period, that is the time elapsed between the primary infection and the metastatic joint lesion is most indefinite. The duration of the active stage, that is the stage of great pain and acute inflammation may vary from a few days to several weeks. The complete recovery of the infected joint may require only 1 or 2 weeks or as much as 6 to 12 months. The outcome may be a normal joint or any degree of permanent change up to bony ankylosis.

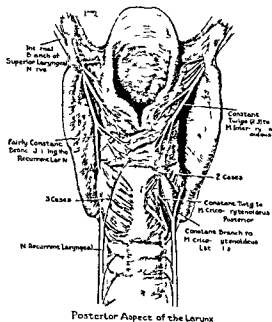
The pathological anatomy of gonococcal joint lesions is varied. The first stage is usually one of moderate serous effusion with swelling of the synovial membranes and infiltration of these membranes with plasma cells and histocytes. As the process advances, large numbers of polymorphonuclear leucocytes appear, infiltrating the synovial membrane as well as clouding the free fluid in the joint. Depending on the severity of the process, erosion of the cartilage and atrophy of the adjacent bony structures may occur. Small areas of decalcification are quite common. With the repair process, exostoses, fibrous adhesion bands, and osseous adhesions may form. The periarticular tissues are usually involved to some extent. Simple inflammatory oedemas are most common, but even phlegmons may occur in very severe infections. The infections of bursae and tendon sheaths are essentially the same with the exception that the bony structures are not involved. It also may be said that infections of the tendon sheaths are often of the severest type with the formation of phlegmonous swellings, abscesses, and extensive lymphangitis. The infections of the periosteum seem to incline toward the formation of exostoses. Osteomyelitis of gonococcal origin is rare but has been described (4, 16).

In order to make a simplified presentation the various arthritis cases may be classified into groups. Many such groups have been proposed and used but in consideration of the material about to be presented it has been found appropriate to use the following classification:

1 Cases of arthralgia, namely cases in which merely pain is the symptom. The physical examination of the joint including roentgenograms, is negative. The spasticity of the muscle groups supplying the joint is of course secondary to the pain.

2 Cases of arthritis with simple swelling and free fluid. The swelling in these cases is of a moderate extent and the free fluid of the joint cavity is not purulent in the large majority of cases. However all gradations from serous to frankly purulent effusions may occur. The roentgenograms show merely the swelling but no bony lesions.

3 Cases of osteoarthritis. In these cases the adjacent bony structures are involved as demonstrated by the roentgen ray. The lesions may be



Posterior Aspect of the Larynx

Fig. 2. Posterior aspect of the larynx illustrating the nerve supply to the intrinsic muscles with especial reference to the interarytenoid muscle.

a more anterior plane than the nerve except for its terminal branches that may be posterior to the nerve. This author also observes that the right recurrent nerve lies more anteriorly on the trachea than the left.

#### NERVES OF THE LARYNX

The naked eye dissections of the 12 larynges showing their intrinsic nerve supply disclosed a constant finding relative to the innervation of the interarytenoid muscle.

It is our impression that the medical students of today are taught both in gross anatomy and in the specialized course of laryngology that the larynx receives its nerve supply from the recurrent nerve and the superior laryngeal nerves, the former being motor while the latter is sensory,

with the exception of its external ramus supplying the cricothyroid muscle. To quote from Sobotta and McMurrich (1914) vol. III, p. 270: "The inferior laryngeal nerve supplies all muscles of the larynx with the exception of the cricothyroid, which is innervated by the external branch of the superior laryngeal nerve." In all of the 12 larynges, this was not found to be so. On the contrary, there was a constant group of nerve filaments (varying from two to five in number) branching out in the interarytenoid muscle derived from the lower division of the internal laryngeal nerve. There was a constant twig also from the recurrent nerve to the cricoarytenoid posterior (abductor of the vocal cord) passing deep to the muscle but in only 2 instances reaching the interarytenoid muscle. In 3 cases there was a slender twig from the recurrent nerve reaching the interarytenoid muscle running alone over the cricoarytenoid posterior, while at the lateral margin of the latter muscle a fairly constant ascending twig joined with a similar descending twig derived from the internal laryngeal nerve (the so-called *rami communicantes*). A constant deeper anterior ramus supplied the cricoarytenoid lateralis (adductor of the vocal cord) and thence passed to the thyroarytenoid and smaller muscles in the aryepiglottic fold.

#### CONCLUSIONS

The recurrent nerve tends more commonly to be anterior to the artery on the right side than on the left, while the reverse may be said of the left side.

It should be borne in mind that while the nerve may be posterior to the lower branch of the inferior thyroid artery, it may appear anterior to the upper branch.

The relations of both recurrent laryngeal nerves to the trachea are essentially alike.

The interarytenoid muscle receives its main innervation from the internal laryngeal nerve and occasionally an additional twig from the recurrent laryngeal nerve.

Only seven of the patients were women, this low incidence is partly due to the difficulty of proving an arthritis in the female to be gonococcal in origin. In the male the proof of gonococcal infection is usually easy. The large majority showed positive urethral smears, the rest showed the organisms either in the prostatic secretion or in the joint fluid.

As stated before, the incubation time, that is the time elapsing between the appearance of the urethral discharge and the appearance of joint symptoms, is indefinite. Findings based on our experience have indicated that this period is usually fairly short. As shown in Table III, in almost one half of the cases joint symptoms developed within 3 weeks.

TABLE III—INCUBATION TIME IN DAYS

	Number of cases
1 to 20	302
20 to 60	187
More than 60	84
Unknown	31
Total	610

The statement that no age is exempt is correct, but because gonorrhea is primarily an infection of the young adult, most arthritis cases occur at that age (Table IV).

TABLE IV—AGE INCIDENCE

Age of patient in years	Number of cases
Below 20	29
20 to 30	360
30 to 40	156
40 to 50	51
50 to 60	8
Total	610

The fact that gonococcal arthritis may not appear at the first attack of gonorrhea but at some later attack is apparently true since 345 of the 610 patients had suffered repeated attacks of gonococcal urethritis whereas only 105 patients had experienced arthritis with the previous urethral infection. It did not seem however that the repeaters presented more severe attacks as is frequently stated.

The frequently expressed opinion that gonococcal arthritis usually attacks only one joint is probably wrong. Of the 610 patients not less than 410 suffered from multiple joint lesions. It has also been noted that practically every case records multiple ephemeral joint pains before the infection of one or more joints became outstanding. These preliminary, usually rather vague,

symptoms were not counted as arthritic in spite of the fact that they probably were.

It is difficult to classify the material according to the severity of the joint infections. The clinical pictures are as varied as those of gonorrhea of the genito urinary tract. The classification as to the type of arthritis helps only a little since the large majority belongs to type 2. Temperature is only a fair index of severity, as is pain. However, the attempt has been made to keep all factors in mind when groups of cases are discussed according to the treatment they received. Table V gives an idea of the frequency of temperature rises and also of the pain encountered. "Normal temperature" includes everything up to 99 degrees F, "raised temperature" everything from 99 degrees to 102 degrees F, and "high temperature" everything above 102 degrees F. Since every patient suffered from pain, only those cases were specially selected which required sedatives, and these again were classified as 1, "moderate," 2, "severe," and 3, "very severe." The rest were classified as "mild." There seems to be some relation between the temperature and the pain but it is not a very intimate one. Aside from these two factors the local joint changes have been considered in an attempt to classify the material into (A) mild (B) moderately severe, (C) severe, and (D) very severe cases.

TABLE V—PAIN AND TEMPERATURE

Pain	No of cases	Temperature	No of cases	Per cent
Mild	312	Normal	121	38
		Raised	197	58
		High	12	4
Moderate	103	Normal	20	19
		Raised	75	73
		High	8	8
Severe	148	Normal	14	9
		Raised	113	77
		High	21	14
Very severe	47	Normal	3	6
		Raised	37	79
		High	7	15
Total	610	Normal	158	26
		Raised	404	66
		High	48	8

It was quite necessary to do this, since without this classification our therapeutic efforts would appear absurd. It is quite natural to let a mild case go without treatment with the result that the fairly large number of untreated cases makes a far better showing in reference to their hospital stay than do the treated cases. Table VI therefore gives the summary of this classification at tempt, and this will be adhered to in the discussion of the therapy.



of the atrophic type, usually rarefactions, or of the hypertrophic type exostoses. Cases of periosteal infections are included.

4 Cases presenting phlegmons. These are rare cases in which the infection is so vehement that the adjacent soft parts show great swelling with marked lymphangitis. Suppuration is common in these cases. They are particularly prone to occur in tendon sheath infections. If they occur in and around one of the major joints, ankylosis is the usual result (13).

The therapeutic efforts have been varied, always a sure indication that nothing has been very satisfactory. For the purpose of a short resume they may be classified as efforts directed (1) toward the whole organism, (2) toward the primary focus, and (3) toward the infected joint. The first group contains all the so called immunological procedures, injections of gonococcus vaccines, of sera supposed to contain specific antibodies, and of sera supposed to contain specific antitoxins (5, 7, 19, 27). Here also belong the many non specific proteins which have been used widely in the last 15 years. Horse serum, typhoid vaccine, whole milk, and casein are the more important ones. Even artificial tertian malaria infections have been used to hasten a cure (11, 12, 24). To this group belong also the efforts to eradicate the infection by chemotherapeutic means: acriflavine, mercurochrome, and metaphen being used especially for this purpose (32, 33). The efforts of the second group, namely, the attack of the primary focus, have been mostly along the lines of routine treatment of gonorrhoea. Massages of the prostate and of the seminal vesicles, and irrigations of the lower urinary tract have been widely used and widely sponsored. The attempts to eradicate the focus by injections of Pregl's solution into the seminal vesicles directly (25, 26), by injections of collargol into the seminal vesicles through the vas, and by radical vesiculectomy, also belong here. The treatments of the metastatic focus have also been multiple and quite frequently contradictory. Many advise fixation of the joint, even for several weeks (6) while many more advise active motion as early as possible (10, 17, 20, 27, 34). The first group is primarily concerned with the pain symptom, the second with the ultimate function of the joint, but both groups claim quicker healing as a result of their therapy. Local heat including diathermy, various ointments, aspiration of the joint even surgical exposure and irrigation of the joint have been practised and recommended (3). A newer treatment of the metastatic focus is the roentgen ray (3, 15, 18, 21, 22, 31). Nearly all the various

treatments will be discussed with the presentation of the material observed.

The material which forms the basis of this report has been taken from the records of Bellevue Hospital in New York. Only the unquestionably positive gonococcus arthritis cases from November 1, 1922, to January 1, 1928 have been included. The cases of the previous 7 years have been reported by Collings (6). Table I gives the number of cases, their classification as acute or chronic (all cases which had had arthritic symptoms for more than 4 weeks were classified as chronic), their disposal at discharge, and the duration of hospital stay. Only those patients who were discharged by the medical staff to their homes can be used for comparative therapeutic statistics. Some patients left of their own volition irrespective of their status and a further number were transferred to other hospitals because of our shortage of beds.

TABLE I—CLASSIFICATION AND DISPOSAL OF CASES

	Number of cases
Acute cases (513)	
Discharged home	337
Left voluntarily	4
Transferred	102
Chronic cases (97)	
Discharged home	53
Left voluntarily	17
Transferred	1
Total	610

Average stay in hospital acute cases 19.0 d. vs.  
Average stay in hospital chronic cases 25.5 d. vs.

Grouping all the cases as to their hospital stay, it is seen (Table II) that almost 70 per cent required less than 3 weeks of hospitalization. Practically all the cases when discharged home were sufficiently improved to be able to walk, and since the large majority of the patients suffered from infections in the lower extremities this is a fair indication of the average hospitalization time required. It seems that this is an extremely important point. Without the careful cognizance of fairly large averages, one is easily misled into therapeutic enthusiasm concerning a small number of cases.

TABLE II—DURATION OF HOSPITAL STAY IN DAYS

	Number of cases
1 to 10	246
10 to 20	173
20 to 30	81
30 to 40	53
40 to 50	53
Total	610

Roentgenograms have been taken in 132 cases. A few of these were negative, the rest showed all varieties of joint lesions from slight enlargement of the joint cavity to bony ankylosis. The peculiar small round decalcification areas close to the joint surface which are supposed to be characteristic of gonococcal arthritis showed many times but because of lack of comparative material it is impossible to say whether these are really characteristic.

White cell and differential counts were made in 23 cases. These are not at all characteristic. The average count is as follows: 12,500 white cells per cubic millimeter with 77 per cent polymorphonuclears. Fluctuations from 8,300 to 20,800 in total counts and from 64 per cent to 91 per cent in polymorphonuclear counts were found.

A review of particular therapeutic efforts made should be preceded by a careful realization that untreated cases do not fare very badly. Table X illuminates this fact very well.

TABLE X

Untreated cases	Number of cases	Average stay in hospital, days
Total	150	7.9
Cases discharged home	71	8.0
Classified as to severity		
Mild	17	4.1
Moderately severe	44	8.5
Severe	10	13.1
Very severe		

However these cases had some treatment practically all of them received daily irrigations of the anterior urethra with an antiseptic solution, whenever the pains were severe, a sedative of some kind was prescribed and a number of these patients helped themselves by local heat treatment given by means of screened electric lamps which were kept in the ward. None of them however was treated by any specific method. They were given rest in bed 3 meals a day and practically nothing else. As soon as their pains had abated sufficiently they were discharged home or to the Out Patient Department. On the other hand, it must be admitted that these untreated cases were not consecutive but remained untreated either because of external causes or because their symptoms did not appear urgent. In consequence, these untreated cases are in the average a trifle milder than the treated cases.

The largest group of treated cases is the one treated by gonococcus vaccines. Various types of vaccines were used, but none was autogenous. Most of the vaccines were made by the New York

City Board of Health, others were made by Burbank, by the Rockefeller Institute and by several commercial houses. The initial dose was invariably small, about 5 to 25 million, the increase was gradual and the highest dosage reached was 1000 million. The vaccines were given in intervals from 3 to 8 days and were usually injected subcutaneously or intramuscularly. A small group received intravenous medication. There were no outstanding results. Some of the patients who suffered a marked temperature rise after the injections—this was quite common after intravenous medication—experienced a shortlived relief from pain, identically with the patients who received other foreign protein injections. There was no evidence indicating increase in immunity against the gonococcal infection, in spite of the fact that there was an apparent increase in tolerance to the injections. It was the rule that a patient receiving many injections of gonococcus vaccine finally failed to react in any way to the injections. Even the local reaction, redness, swelling and so on which usually persisted longer during the series of injections than the general reactions such as chills and fever, finally failed to appear. Quite a number of cases had received gonococcus vaccines before coming to Bellevue Hospital, many of these refused the treatment. Altogether it appears as if the somewhat questionable and shortlived result of the gonococcus vaccine treatment is that in common with foreign protein therapy (19). In view of the annoying toxicity of the gonococcus vaccines, however other foreign proteins are preferable. Table XI gives an idea of the therapeutic result.

TABLE XI—THERAPEUTIC RESULTS OF GONOCOCCUS INJECTION TREATMENT

Cases treated with gonococcus vaccines	Number of cases	Average stay in hospital, days
Total	253	21.1
Cases discharged home	209	21.0
Classified as to severity		
Mild	24	10.0
Moderately severe	103	16.1
Severe	15	31.2
Very severe	6	41.1

The other types of treatment will have to be discussed in groups there are not enough cases from which to draw statistical conclusions. The efforts to eradicate gonococcal infection by chemotherapy are numerous. Only a few of these have been repeated at Bellevue Hospital. There are really only 3 chemicals which have been tried fairly thoroughly, namely Pregl's solution, mercurochrome and metaphen.

TABLE VI—CLASSIFICATION

Degree of severity	No of cases	No of cases discharged home	Average stay in hospital of cases discharged home—days
Mild	71	45	7.7
Moderately severe	204	203	13.0
Severe	217	128	27.2
Very severe	24	14	30.3
Total	610	390	18.6

The material in Table VII may be viewed according to the classification into types as described before

TABLE VII—TYPES

Type	No of cases
1	6
2	483
3	44
4	5
Total	610

It is possible that many of the cases of type 2 would have been grouped as type 3 if more careful roentgen ray studies had been made. As it is type 3 contains the more severe cases of osteoarthritis and osteitis in which roentgen ray diagnosis was thought to be essential.

The various joints found affected can be listed in reference to their frequency as follows. Knee, ankle, foot, wrist, hip and so on. Table VIII gives the complete list.

TABLE VIII

Joints	Number of occurrences
Spine	18
Mandibular	15
Sternoclavicular	15
Sacro iliac	15
Upper extremity	244
Shoulder	49
Elbow	35
Wrist	101
Hand	25
Fingers	34
Lower Extremity	995
Hip	17
Knee	400
Ankle	340
Foot	118
Toes	51
Heel	63

The preponderance of arthritic infections of the lower extremities over those of the upper is very marked, the ratio being 4 to 1. This is possibly due in part to the fact that patients with arthritic pains of the upper extremities do not apply for hospitalization as readily as those with arthritis of the lower extremities, which makes locomotion

impossible. An attempt was made to demonstrate the influence of occupation on the localization of the arthritis. It is possible that joints which are used much and which are exposed to frequent, even if slight, traumas would be more readily affected than other joints which were spared this frequent insult. Unfortunately we did not have a large enough series of upper extremity workers, as tailors, furriers, machine operators, and so forth, but we did have 73 chauffeurs among the 610 patients. Since a chauffeur uses his legs almost continually in driving and sometimes strenuously so, his upper extremities while active also are doing much less strenuous work. Table IX gives the joint lesions in chauffeurs in comparison to the joint lesions of the total 610 patients.

TABLE IX—JOINT LESIONS IN CHAUFFEURS

Joint	No. of occurrences
Spine	1
Mandibular	1
Sternoclavicular	3
Sacro iliac	2
Upper extremity	16
Shoulder	4
Elbow	2
Wrist	1
Hand	2
Fingers	1
Lower extremity	90
Hip	5
Knee	31
Ankle	33
Foot	16
Toes	3
Heel's	8

The relation between infections of the upper extremities and those of the lower in chauffeurs is 1 to 5.6, a still greater discrepancy than is found in the total material. There is also a relatively greater preponderance of ankle and foot infections. This seems to indicate that the occupation has something to do with the location of the arthritis, but that it is probably a minor factor.

A few words about other gonorrhoeal complications in this group of patients will suffice. Endocarditis has not been encountered in this series. Eye complications have been fairly frequent. The majority of these numbering 11, were due to direct outside infections resulting in conjunctivitis; only 2 were of the metastatic type. The outcome was favorable in all cases. Twenty-three patients suffered additionally from epididymitis and one patient developed a penile urethral abscess. Three patients developed a severe lymphangitis in the area of drainage, 2 in the groin and 1 in the axilla.

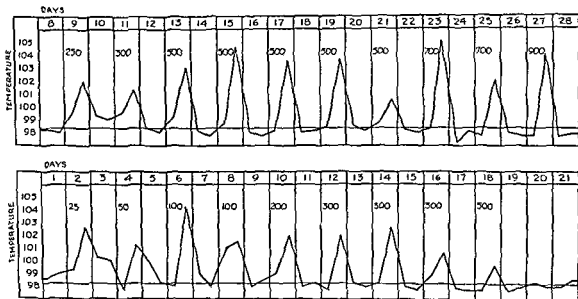


Chart 1 Curve showing effect produced by injection of typhoid organisms on alternate days The numbers indicate millions

Chart 2 Effect of injection of typhoid organisms

with typhoid vaccine, but when they do occur they are followed by temporary improvement. Milk has the drawback of being always contaminated and aside from the fact that the dead bacterial bodies may be toxic it cannot be safely sterilized. The average hospital stay of patients treated with foreign proteins other than typhoid vaccine was 19 days.

Only a few times has the focus of infection been the center of the therapeutic attack. After the enthusiastic reports of Stellwagen on the treatment of gonococcal arthritis by the injections of Pregl's solution into the seminal vesicles, this method was tried in 3 cases. Every patient received 3 injections into both seminal vesicles at intervals of 3 to 4 days. There were no effects discernible in reference to the arthritic condition. One of the patients developed a short termed hematuria after the second injection. In each case perivesicular infiltrations could be felt several days after the last injection. It may be said that the seminal vesicles are neither the most common foci of infection nor is the infection ever limited to the seminal vesicles.

Systemic prostatic massages, namely one every 3 to 5 days were carried out in 30 cases. Four times fairly high temperature reactions occurred after the massage. There were no evidences that the treatment had any influence on the arthritic condition. The average hospital stay of the cases treated thus was 22 days.

The local joint condition has always demanded the greatest attention and while an arthritis really belongs to the field of orthopedic surgery, the urologist usually cannot avoid carrying out some therapeutics. At Bellevue Hospital the attempt was usually made to relieve all severe pains. The most reliable means for doing this is a well applied cast. Casts have been used on 144 joints. The average time of immobilization was 10 days. Fifteen times the cast had to be renewed and 7 times the cast had to be removed on account of increased pain. The immobilization apparently had no influence on the time of invalidity but relieved the pain successfully in almost all cases. As already pointed out immobilization also has its drawbacks. The numerous favorable reports on the use of early active motion of the affected joints for therapeutic purposes deserve attention (10, 14, 20, 34). They come from reliable sources and concern a method which arose on the basis of sound pathological and clinical observations. The technique usually employed is as follows. As soon as the patient can possibly be moved he is lifted into a very hot bath and is asked to execute active motions of the affected joint. This is usually possible due to the relaxation in the water bath. The claims are quicker recovery and fewer ankylosed joints. It is unfortunate that due to circumstances this method could not have been used.

Lately the deep roentgen ray has been tried

Twelve patients were treated with Pregl's solution intravenously. Injections of 10 to 40 cubic centimeters were repeated frequently. Some patients received 12 injections, others only 2. There were no untoward effects. One patient developed an acute epididymitis during the treatment. The results were disappointing. None of the patients made a speedy recovery and their average hospitalization was 37 days. Fourteen patients received intravenous injections of 1 per cent mercurochrome solution. The dosage varied from 3 to 5 milligrams per kilogram of body weight. The number of injections varied from 1 to 5. There were no serious untoward effects. However, temperature rises to 104 degrees F were common, some of the reactions were accompanied by a temperature rise to 103 degrees F. Vomiting occurred three times. Albuminuria was observed a few times shortly after the injections, hæmaturia was never seen. One patient developed an acute epididymitis during the treatment, but none of the patients developed infections in new joints. The results were fairly good. Recovery seemed to be slightly hastened and seemed to be slightly more complete than in other similar cases. The average hospital stay was 18 days. Metaphen solution was used in 15 cases intravenously. The dosage was always 10 cubic centimeters of a 1.000 solution which is put up in ampoules. Injections were repeated from 2 to 5 times. There were no untoward and no therapeutic effects. Two of the 15 patients developed new joint infections after the treatment had been started. This seems to speak very strongly against any general antiseptic effect of the medication. The average hospital stay was 21 days. Altogether our chemotherapeutic efforts have been disappointing.

Another group of therapeutic endeavors which has been used very widely is "foreign protein therapy." A great variety of substances has been used. It is at least questionable if substances such as gonococcus vaccines and mercurochrome should not be placed here also. Both frequently produce body reactions which are sought for in foreign protein therapy and their therapeutic efficiency seems to depend somewhat on those reactions. It is impossible to go into the theoretical and historical aspect of protein therapy; suffice it to say that this therapy constitutes an attempt to accelerate the complex defensive mechanism of the body by giving it a protein shock. The type and quantity of shock is debatable, but most efforts are directed toward a temperature rise of some magnitude. Whatever else goes with this seems to be not only acceptable but is considered now to be

the primary therapeutic factor. The illusion that a high temperature *per se* kills the gonococcus has been shattered. In our series typhoid vaccine has been the principal foreign protein. It has been employed in 31 cases. In all cases except 3, it was used intravenously. The initial dose was usually 25 million organisms, and this dosage was gradually raised to even 1,000 million to get the desired temperature rise. The number of injections varied from 2 to 13. The reactions were as a rule vehement and intensely disagreeable for the patient. Chills were usually very marked and so was the accompanying malaise. After the reaction, which was usually ended in 6 to 8 hours, the patient felt markedly improved. The pain in the joint was nearly always appraised as lessened. But there were no objective changes in the joint condition or at least not more than the gradual diminution of swelling which is seen in almost all cases. It is surely debatable if the subjective improvement in the patient's condition is not due to a psychological mechanism. He is so wretched during his protein shock that his primary sickness impresses him less than before. The fact that usually a slump in the patient's subjective condition appears after 2 to 3 days corroborates this. Recently several reports have been published praising tertian malaria as a therapeutic agent in acute and chronic gonorrhœa (11, 12, 24). The reports have not been very convincing and it was not deemed feasible to employ such heroic weapons, but it was possible to produce almost typical tertian malaria temperature curves with graduated intravenous injections of typhoid vaccine which were given every second day (Charts 1 and 2). The results were disappointing, aside from this, the treatment is so rigorous that one would rather prefer the disease to the therapy. The average hospital stay of the patients treated with typhoid vaccine has been 24 days.

The other foreign proteins have been used in lesser numbers. Casein has been used 9 times, whole milk 3 times, the patient's own joint fluid (10 to 40 cubic centimeters) 5 times, and the patient's own blood (20 cubic centimeters) 10 times. The literature on these foreign proteins is large and mostly enthusiastic (1, 8, 9, 23, 28, 30). However, our own results have been negative. This is particularly true with the intramuscular joint fluid and whole blood injections. There were no results except the patient's discomfort where the substances were deposited usually in the gluteal muscles. This is really surprising in view of the highly laudatory reports on *Eigenbluttherapie*. Aolan and milk are slightly more efficient. Reactions are not as regularly elicited as

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## CORRESPONDENCE

### PANHISTERECTOMY TECHNIQUE

To the Editor In your February issue Dr E H Richardson, of Baltimore describes what he calls a simplified technique for abdominal panhysterectomy In his article he mentions the technique which I presented in detail in 1916, at the meeting of the American Association of Obstetricians Gynecologists and Abdominal Surgeons and compliments me by stating that my method is better than any which had been previously devised My paper was published in the *Transactions of the Association and also in the American Journal of Obstetrics and Diseases of Children*, vol lxxv No 2 1917

I have studied his article with very great care and have discussed it with several of our local surgeons who long since have adopted my technique In some of his details we agree perfectly, but in others we do not and I think the latter are subject to comment (1) He emphasizes the importance of separating the rectum from the upper end of the vagina so that he can sever the vagina below the tip of the cervix Normally the rectum is not attached to the vagina for about one inch at the upper end, so that there is no necessity whatever for making any further separation such as he pictures in Figure 6 Indeed the rectum is frequently separate from the vagina for at least 2 inches so that repeatedly I have taken advantage of that separation in complicated cases to split the posterior vaginal wall downward after removing the uterus in order to introduce the ends of a gauze fluff (over which is attached the mobilized sigmoid) which is to be withdrawn after one week through the vagina (2) He frees the uterus so extensively that by compressing the vagina antero-posteriorly by the fingers he brings its walls together below the cervix as shown in Figure 7 and then in

cutting across he cuts so far below the cervix, as shown in Figure 9 that the vagina is necessarily shortened by nearly or quite one inch By my technique the entire length of the vagina is utilized by his technique the shortening of the vagina must necessarily result in more or less dyspareunia and thus prove a fatal objection (3) In separating the parts posteriorly we both detach the uterosacral ligaments but in completing his operation he directs that these ligaments shall be clamped divided, and ligated close to their cervical attachments By my technique these ligaments are replaced as nearly as possible in their normal relationship to the parts and they are utilized in peritonealizing the pelvic floor

None of us here can see how by his technique there is any diminution in hemorrhage, any less danger of infection from the vagina, and most certainly no gain in time

In conclusion my operation was originally based on over two thousand hysterectomies, has been demonstrated to large numbers of surgeons from whom it has received the warmest approval, and with an added experience of several thousand cases I have seen no reason to make a single change in the technique as published I more and more, however, emphasize the importance of thorough *personal* preliminary cleansing and sterilization of the vagina and endometrium I very recently, went over all of my deaths following panhysterectomy and in not a single instance could death be attributed to any infection coming up through the vagina Hemorrhage is negligible In ordinary cases there is no shock No ureters have been injured In simple cases the operation has been repeatedly completed in 15 minutes

Columbus Ohio

J F BALDWIN M D

for the relief of pain. Our dosage has always been 25 per cent of a skin erythema dose with copper and aluminum filters. Cross fire was used invariably and the treatment was usually repeated after an interval of one week. Of the 27 patients on whom the treatment was used, 22 reported a marked relief from pain after the first treatment, 2 after the second treatment, 3 were not relieved. The average patient received 2 treatments, 8 patients received 4 treatments the highest number given. If several joints were involved and only one was treated by roentgen ray, only the one treated was improved. The roentgen ray treatment did not have any apparent influence on the time period required for recovery. However, the fact that the treatment relieved the pain in many cases without fixation is encouraging. The mechanism of this effect is debatable. It is certain that the roentgen ray does not kill the gonococcus. The observation that the roentgen ray in large doses diminishes the fibroblast reaction and destroys primarily the endothelial elements may be explanatory in the sense that certain phases of the inflammatory reaction in the joint are diminished with a consequent decrease in swelling. It may also be that the above named elements are not destroyed by the relatively small roentgen ray dosage but rather that they are stimulated in their activity, which is primarily that of defense against the invading organism. The fact that even very small doses have been successful namely, doses of 5 to 8 per cent of the erythema dose, would speak for the latter explanation.

#### CONCLUSIONS

In conclusion it may be said that we have no specific treatment for gonococcal arthritis at the present time. The primary consideration in planning the treatment should be the end result namely, the unimpaired function of the joint. This end result may be endangered by fixation. On the other hand the outstanding distressing symptom, pain in the joint is relieved most efficiently by fixation. It seems that the roentgen ray will prove very helpful here, and it is also likely that the principle of early active motion which has been so beneficial in other pathological joint conditions will also prove its worth in gonococcal arthritis.

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such clots with thrombi occurring spontaneously, the so called static thrombi of Aschoff, and the latter show a tendency to organize very slowly

When we consider the comparatively high incidence of pulmonary embolism following radical removal of varicose veins, when we consider the almost entire absence of saphenous thrombi as the source of fatal pulmonary embolism when we consider the important fact that these patients are not immobilized at all but are encouraged to pursue their daily work, thus eliminating the factor of stasis in the formation of "spontaneous" clots, we can feel justified in advising the injection treatment, even if the theoretical possibility of a thrombus breaking loose is to be admitted. However, if such a thrombus becomes infected, or if massive thrombi are produced close to the saphenofemoral junction, where the sucking action of respiration can be demonstrated, the danger of embolism must become greater

Preliminary ligation of the long saphenous vein, previous to injections, or radical removal of all visible dilatations after a ligation at the saphenofemoral junction, are very useful procedures and are still employed in selected cases. No new method can ever displace entirely the fruitful work of master surgeons, who have contributed to the surgery of varicose veins. The injection treatment is simple, safe, effective and economical, but will be rapidly discredited, unless used in its proper place.

GÉZA DE TAKÁTS

### JEJUNAL ULCER FOLLOWING GASTRO-ENTEROSTOMY

**J**EJUNAL ulcer is one of the most dreaded and perplexing complications of gastro-enterostomy, although fortunately it does not occur frequently—probably nearer 2 per cent (Mayo) than the 6 to 10 per cent men-

tioned by Lahey. It occurs at or near the line of anastomosis, generally in the efferent branch of the jejunal loop, but sometimes encroaches upon the stomach itself. It gives rise to very disturbing symptoms similar to those of duodenal ulcer, the pain and tenderness, however, lying more to the left.

Jejunal ulcers are difficult to demonstrate with the X ray, although they often are of considerable size and embedded in massive adhesions. They may extensively involve the surrounding structures, such as the colon, into which they occasionally perforate.

If medical treatment fails, which it is apt to do, one of several operations can be done perhaps preceded by a preliminary jejunostomy if the patient's condition demands it (Balfour).

1 The anastomosis may be undone, the diseased bowel resected and re-united, and the opening in the stomach closed, thus re-establishing the *status quo ante*.

2 After the anastomosis has been undone and the ulcer excised, a new gastro-enterostomy may be performed, although there is always danger of a recurrence of the trouble.

3 When possible, a partial resection of the stomach may be done, including most of its acid bearing area together with the anastomotic opening and a section of the diseased bowel, but even this does not always prevent a recurrence.

4 In case of a colonic fistula it may be necessary to resect a portion of the colon along with the small bowel and stomach.

Manifestly these are all more or less formidable and dangerous procedures, especially following a no loop posterior gastro-enterostomy.

In order to prevent jejunal ulcer we should know its cause. A number of theories have been suggested but none of them is entirely satisfactory.



# EDITORIALS

## SURGERY, GYNECOLOGY AND OBSTETRICS

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JULY 1929

### THE TREATMENT OF VARICOSE VEINS

UNPRECEDENTED interest has been aroused in the ambulatory form of treatment for varicose veins. This disease, which permits the distinct recognition of a hereditary disposition but is aggravated by traumatic, infectious, and postural factors, is more widespread than our operative records would indicate. Of one hundred consecutive cases, 75 per cent of the patients would not consider operative treatment, partly because of lack of time but chiefly because of the *horror scalpellii*. While the disease may start in patients in the early twenties, it will not produce disturbing symptoms for many years, yet as the disease progresses, as the phlebitis, the eczema, and the ulcer develop, these incapacitating conditions will mean months and years of economic loss to the patient. The varicose ulcer, the *crux medicorum*, wanders from doctor to doctor, from hospital to hospital, and the treatment of such end stages is long and disappointing.

An ambulatory form of treatment then, undertaken previous to the onset of complica-

tions and permitting the patient to continue his or her daily duties, means real progress in treatment, provided the method is safe and effective.

The safety of the injection treatment is maintained first of all by selecting the suitable case. Acute superficial phlebitis and deep thrombophlebitis are definite contraindications. Hyperthyroidism and acute tuberculosis supersede in dignity and importance all local treatment for veins and should be attended first. Many other diseases, such as diabetes and hypertension, are not a contraindication and should be treated simultaneously. But most important is the early recognition of partial or total arterial occlusion, which is associated so frequently with dilated veins. Patients with impending juvenile or senile gangrene should be carefully excluded from the injection treatment. The safety of the injections is furthermore enhanced by using sugar solutions, dextrose, and invert sugar, as perivenous injections will not result in necroses, as frequently reported after the use of other hypertonic or chemically highly irritant substances.

The effect of hypertonic sugar solutions is an irritation of the intima which becomes hyperæmic and oedematous. With the help of adequate compression following the injection, the inflamed walls of the vein are approximated and a fibrinous exudate seals the lumen of the vessel. In this fibrinous network the blood will clot, secondarily to the endophlebitis. This is quite an important factor in the firm adherence of the clot, as the clot is really organized from the very beginning. Histological studies have been made comparing



1 *Traumatism and submucous hemorrhages from crushing of the tissues with holding forceps* This would seem reasonable if it were not for the fact that jejunal ulcers occur when forceps have not been used and other forms of traumatism have been avoided

2 *Non absorbable sutures* Unfortunately their abandonment in favor of catgut has not done away with the trouble

3 *Imperfect suturing* This occurs in other gastric operations and ulcers do not result Furthermore, the jejunal ulcers often do not come in contact with the suture line

4 *The acid gastric contents* which pass directly into the non resisting jejunum This would seem to be such a reasonable solution of the problem that many surgeons, especially abroad, have widely resected the acid bearing area of the stomach, sometimes removing so much that the remainder was insufficient for the requirements of the patient, but numerous reports have shown that ulcers have occurred in spite of these extreme operations In fact, the removal of what was originally the acid bearing area does not prevent the remainder of the stomach from developing acid forming functions and in addition, jejunal ulcer may appear when little or no acid is present, or even when no gastro enterostomy has previously been done

5 *Disturbance of innervation* The principal support of this theory seems to be derived from experience with von Eiselsberg's procedure of permanent closure of the pylorus in gastro enterostomy, which was found to augment enormously the incidence of jejunal ulcer This could hardly be caused by an increased flow of gastric contents through the

new opening, because ulceration does not occur frequently when the pyloric obstruction arises pathologically Hence it was thought that it might be due to a disturbance of the innervation about the pylorus leading to changes in the pancreatic and gastric secretions However, even if we admit the truth of this explanation in von Eiselsberg's operation, it is difficult to see how it applies when the pylorus is not interfered with Further more, division of the autonomous nerve supply has even been suggested as a cure for ulceration

6 *Constitutional predisposition* This would, of course explain the phenomenon but until more convincing proof is presented it would seem to be a begging of the question

Apparently, there is no certainty regarding the etiology of jejunal ulcer and no way of preventing jejunal ulcer when a gastro enterostomy is done All of the causes mentioned and perhaps others, may play a part, but none of them seems to be a constant factor Hence in addition to avoiding these causes it seems evident that we should try to plan our operations so that if recurring ulcers appear we can subsequently take care of them without too much danger and difficulty

At a recent meeting of the American Surgical Association, Dr Balfour of the Mayo Clinic emphasized this view, advocating gastro enterostomy or limited resections (Billroth I) when practicable, instead of the more extensive procedures claiming that the results are sufficiently good while the mortality is lower and that in case further ulceration appears the operative outlook is better

LEONARD FREEMAN

# MASTER SURGEONS OF AMERICA

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## GEORGE W GUTHRIE

A GENTLEMAN of the old school, a surgeon of distinction, a cultivated leader of his community, a staunch and devoted friend. In this mental picture, still so vivid, of Dr George W Guthrie, who died at Wilkes Barre, June 1, 1915, these attributes seem to portray his character. Born in Guthrieville, Chester County, Pennsylvania, he was a descendant of Scotch Presbyterians who had emigrated and settled in Eastern Pennsylvania early in the eighteenth century. He began his career as a teacher in the Public Schools and, because of his practical experience and interest in educational problems, he became a director of the school board, in which capacity he served for forty years and impressed his leadership on the reorganization and direction of the Public School System. In his twenty fifth year he first turned his attention to medicine, beginning his studies under the old preceptor system and graduating later from the University of Pennsylvania.

It is difficult adequately to sketch the career of the man, who, as I affectionately recall him, represented an ideal, a prototype of what seemed finest and best in the profession of medicine. It was not so much that he had attained distinction in practice, first as family physician and later as surgeon—this was recognized by the community who elected him to the staff of the Wilkes Barre City Hospital and consulting surgeon on the staffs of hospitals in adjacent communities, it was recognized by exclusive organizations as when he was chosen a Fellow of the American Surgical Association. It was the associated attributes, attributes which round out a man no matter what his profession, which made George W Guthrie admired, respected, and beloved. In the blood of his veins there ran a strict sense of all that was honorable in manhood. All that he said rang so true and all that he did was so untaunted with selfish interests, that he soon became the confidant and friend and the leader, guide, philosopher and friend, if you choose, of his associates. He was, in fact, the dean of the medical fraternity throughout the Wyoming Valley and it was largely the reflection of his influence that in Wilkes Barre there was during his day a very unusual group of splendid physicians and surgeons.

He recognized, as few do, his obligations to organized medicine and carried much more than his share of the responsibilities of upholding the standards and



GEORGE W GUTHRIE  
1845-1915

of thousands of chariots! Arthur's sword Excalibur! What is that to the sterilized scalpel of the surgeon! And Aladdin and his wonderful lamp are far outdone by the wizard Edison with his electric lamps and by Roentgen and his rays "

There was Guthrie the surgeon, Guthrie the leader of his medical community, Guthrie the lover of good books and poetry. He not only appreciated the broadening effect of familiarity with good literature, history, and romance, but he loved poetry. Proud of his Scotch ancestry, he revelled in the romantic history of Scotland and her great men, but, of all, Robert Burns and his poetry held first place in his heart. His conversation and friendly greetings and his more formal after dinner speeches were given an added charm by the freedom with which he quoted at random from his favorite authors. How few there are today who could match him, none who could excel.

William James once wrote "I am done with great things and big things, for great institutions, and I am for those tiny molecular moral forces that work from individual to individual, creeping in through the crannies of the world like so many soft rootlets or like the capillary oozing of water, but which, give them time, will *rend the hardest* monument of man's pride "<sup>1</sup>

Thus do I conceive the influence of Guthrie's life. There were in his community no great institutions or large movements, but the tiny ripples of his influence spread through his contacts with physicians of state and nation, over the length and breadth of the land. Thus the force of his character left its imprint for the good of his profession and for the making of a better world.

CHARLES H FRAZIER

<sup>1</sup> William James: *The New Quest* by Rufus Jon s. page 92

ideals of medical practice and scientific pursuits. Holding high office in city, county, and national societies, he served on committees and commissions too numerous to mention. He played an important part as a member of the House of Delegates during the years that the American Medical Association was in process of becoming the effective organization it now is, finally declining reappointment in 1913 to become a member of its Judicial Council.

All the while he was giving of his time to his large and exacting practice, to his community obligations, and to the demands of the medical organizations with which he was allied.

He was essentially a student of medicine, and was well informed in current literature to which he was no mean contributor. In reviewing his writings one can see that not only was he abreast of the times but foresaw with a clear vision the tendencies of progressive thought. His writings were examples of good diction and there was a charm in his style, especially in his general addresses to physicians and nurses which were replete with wholesome advice. His *By Paths of the Doctor's Life*, a charming paper written in 1904 might today be read with profit and to the betterment of many a physician's life. In 1880 at a time when Listerism was engaging the attention of surgeons throughout this country and Europe he presented his "Essay on Antiseptic Surgery" to the Luzerne County Medical Society. It was a carefully prepared, instructive paper with expressions of opinions from the leading surgeons of the country. At this time some surgeons still doubted the "germ theory of disease," others questioned the efficacy of antiseptic treatment, placing greatest reliance upon absolute cleanliness. Guthrie preached to his fellow practitioners that, in operations of unusual gravity as in opening the peritoneal cavity and the joints, the surgeon who does not follow the exact Listerian method does not give his patient the benefit of the best resources of his profession. As long ago as 1890, many years before the employment of the trained anesthetist, he recognized as unconscionable the habit of surgeons entrusting the administration of anesthetics to junior members of the staff. "The custom of placing the anesthetic in the hands of the youngest man in the operating room—often the merest tyro—is most irrational", and "Next to the man who holds the knife is that of the one who holds the inhaler." How prophetic these commentaries! At that period he decried the practice of tinkering operations on women with neurasthenic disposition such as sequence as nephrorrhaphy, Alexander's operation hysterectomy, double oophorectomy in one and the same patient. He lived and practised at an interesting period in the evolution of surgery. He saw the passing of the nineteenth century and the first fifteen years of the twentieth. As the sun of the nineteenth century had almost set he wrote "How the pulse thrills when we consider what belongs to the last hundred years. The dreams of ancient and mediæval poesy have been more than realized! Chariots and horses of fire! We have harnessed the lightning and hatched it to tens





# THE SURGEON'S LIBRARY

## OLD MASTERPIECES IN SURGERY

ALFRED BROWN, M.D., F.A.C.S. CHICAGO

### HUGO OF SIENA THE COMMENTARIES AND CONSILIA

ONE can hardly imagine a more apt and concise summing up of the medicine and surgery of the fifteenth century than that of Daremberg when he says 'the fifteenth century (more dogmatic more decided than the fourteenth) was a summary and a preface a summary because it presents to us in all possible forms and modes of expression the substance of Arabian medicine of a medicine which is in its general form only a transformation only an assimilation of Greek medicine especially the medicine of Galen—a preface, because in certain aspects quite obscure it is true it permits a glimpse especially toward its close, of some tendency toward the observation of nature in the *Consilia* (collections of observations or consultations), and the dissection of some bodies' It represents a period of dark before dawn and in its early part, at least an interval of marking time until the discovery of printing allowed a wide dissemination of knowledge at a cost which made it accessible to other than the very rich. One does not look then for marked surgical progress during this century and no great man appeared to force it. There is a modicum of excuse for the condition in the make up of the universities in which medicine was taught and the difficulties under which the teaching had to be carried out. The professors had to teach from the manuscript books they had at hand and one can visualize each student being required to transcribe his manuscript with the additions and emendations of the master—a most laborious and time consuming process. Consequently the literature of the period affords us many examples of the works of Hippocrates, Galen and the different authors of the Arabian school each one added to, emended and explained by the teacher who was usually one of the great men of the time. The literature affords also examples of the 'consilia' written by these men, recitals of cases occurring in their experience, case records, so to speak which were used by them in their teaching and which the students transcribed as their notes.

The work of Hugo Benzi or Hugo Sinensis so called from his birthplace, Siena represents a typical example of this form of literature. He was a teacher in great demand for he passed from school to school being called from one to another by the noble in

power in the town in which the teaching institution was situated. He was born in the fourteenth century a member of a prominent family and graduated in medicine at Siena. He then began to travel from one university to another always teaching—in 1399 at Pavia from there to Piacenza then Florence and in Bologna from 1402 to 1427. He then passed to Parma and Padua. In 1428 the Senate gave him permission to teach in Perugia for two years after which he returned to Padua but remained for only a year when he went to Ferrara. He was there at the time of the great council and had the opportunity to attend and learn the doctrines of the great philosophers such as Plato and Aristotle, through listening to the arguments and expositions given at the meetings. When he died is not certain but it was probably about 1439.

Hugo wrote Commentaries on the works of the Ancients but also gives us two books of his own experiences entitling them *A most useful Treatise Concerning the Regimen and Conservation of Health* published at Milan in 1481 and *Very Healthful Councils for all Diseases* published a year later (Bononiæ) 1482.

In what little surgery Hugo writes about he differs hardly at all from the work of the ancients and offers practically nothing new. He is fond of carrying on long arguments which usually lead nowhere as he does when he is discussing the Aphorisms of Hippocrates. After giving his own beliefs he quotes the ideas of Cilen concerning the aphorisms one by one and at the end of each one is as much in the dark as before reading the explanations. For example Hugo takes up one page and devotes another to the quotations from Galen in the discussion of the famous first aphorism of Hippocrates 'Life is short Art is long Time is pressing Experience is fallacious, Judgment is difficult.' When the discussion is over one still can read the aphorism and translate it to his own satisfaction in hundreds of different ways. Nevertheless Hugo's ideas are ingenious though one cannot always agree but they show that he spent much of his time in abstract argumentation which led nowhere. In spite of this he was well thought of by his contemporaries and achieved a great reputation.

For a time at Padua he taught anatomy using human material for demonstration but made practically no progress beyond the then accepted anatomy of Mundinus.

## REVIEWS OF NEW BOOKS

THE author states that *Hydatid Cysts of the Lung in Children* is the first book dealing with the disease in children. It is based on his own experience with 50 cases among 25,000 clinical histories from the children's surgical wards during a period of 20 years and on a comprehensive study of the literature.

The book, including case histories which are well illustrated, a resume, and a bibliography covers 300 pages. The presentation is comprehensive, the arrangement is logical, and the style is clear and forceful.

It is stated that characteristically the clear liquid of the cyst the *tenuis echinococcus* does not contain albumin but may contain micro organisms such as *Bacillus coli communis*, *streptococcus staphylococcus* etc. that experimental injection of fluid intravenously produces symptoms similar to those due to anaphylaxis and that secondary echinococcosis may occur through the migration of daughter cysts developing in the wall of the mother cyst outward from spontaneous rupture of the mother cyst or from spilling of cyst contents during its operative removal.

The X ray is of the greatest importance in the diagnosis of hydatid disease but tumors dermoid cysts etc. must be differentiated. The author considers the complement fixation test of Ghedini conclusive if positive but he has seen it fail in many instances. The precipitation test of Joust and the intradermal test of Trossier and Casoni have been found positive in about 90 per cent of cases. A rapid skin sensitization test is also described as very simple and useful. The author condemns diagnostic puncture as so unreliable and dangerous as to be unwarranted. Complications include infection of a cyst rupture into a bronchus or into the pleural cavity.

Differential diagnosis includes a differentiation between malignant tumors especially sarcoma in case of children dermoid cysts tracheobronchial adenopathy tuberculosis pleuritis lung abscess and liver cysts.

The prognosis in children is far more serious than in adults. In the present series it was 14 per cent. Bronchopneumonia was the chief cause of death in half the patients operated upon. The author states that to improve the prognosis the technique of operation should always be made as simple as possible to endeavor to ward off the slightest risk. The practice of doing the more showy operation in one stage for the more prudent two stage operation should be abandoned.

The author believes that in case of a simple cyst situated peripherally the operation should consist of opening the cyst and extracting the hydatid mem-

brane. Operation for central cyst exposes the patient to such serious risk that it is better to wait for spontaneous rupture into a bronchus which results in a cure in 50 per cent of cases. In case of ruptured cyst the best procedure is incision and drainage.

The greatest dangers attending all thoracic operations are infection, hemorrhage, and pneumothorax. Methods of combating their complications are discussed.

The author expresses the sane opinion that an operation in two stages or under hyperpression is safer than an open pneumothorax.

CARL V. HEDBLOM M.D.

THE American publishers William Wood and Company, have presented us with a most acceptable volume of 585 pages on the *Report of the International Conference on Cancer*. At this conference in London in July 1928, there were more than 102 delegates from 17 countries outside of the British dominions. The United States was represented by 17 Germany by an equal number France by 13. Every British dominion sent its delegates 25 in all and there was a very much larger number of home delegates and members. It was therefore a much larger meeting than the Cancer Control Conference at Lake Mohonk New York, which was held in September 1916 under the auspices of the American Society for the Control of Cancer, where there were but 16 foreign delegates and about 100 delegates and members from the United States and only 32 papers.

In the book containing the London report there are published 128 papers but without discussions. It is interesting to note the relative number of papers devoted to the different problems of cancer. For example, under the title 'Public Action in regard to Cancer' there are but 11 papers. These discuss the educational problem of cancer the importance of getting the correct facts to the public, and the now universally accepted conclusion that the cure of cancer today depends upon education of the people. On the etiology of cancer there are but 13 papers. These discuss cancer research. On the other hand there are at least 38 contributions to radiation in the treatment of cancer while the papers devoted to the diagnosis of cancer are only 11 in number. Discussions of the actual surgical treatment or operations for cancer are included in many of the papers on radiation but are not given the same attention. In the 8 articles on cancer of the stomach surgery and diagnosis predominate. Radium and X rays do not seem to have entered this field as therapeutic agents. The 5 papers on sarcoma of bone are largely pathological. Surgical



The anatomy and mechanism of the various fractures are well described. Treatment of fractures of the ulnum should be conservative even though considerable displacement is present. Lambotte is the most ardent advocate of open operative replacement and fixation but the author's cases show that this is rarely necessary. Fractures between the crest and the body of the ulnum heal in all cases without operation and need only be treated by rest in bed for 3 or 4 weeks.

Sacral fractures frequently involve nerve injuries either through direct lesions of the nerves themselves, or compression by bone fragments or by hematoma. These nerve symptoms may not appear immediately but may be delayed for several days. Most sacral fractures need only bed treatment, averaging 30 days. In case of marked displacement bimanual reposition should be attempted and when impossible, open operation may be required, if extensive nerve injury exists.

Fractures of the rim of the acetabulum may respond to conservative treatment. They are often caused by dislocation of the femoral head. If the fragment interferes with replacement of the head it may require open operation. The results are sometimes unfortunate and the prognosis should be guarded.

Fractures of the pelvic ring are more common and more interesting than those not involving the ring. Two hundred and nine cases are included in the author's series. The entire pelvis should be included in the X-ray examination of all suspected cases.

Separation of the symphysis pubis of more than 15 millimeters is certain to involve damage to the capsule or the ligaments of the sacroiliac joints. Forty millimeters separation will involve a severe tearing apart of at least one sacroiliac joint.

Central dislocation of the head of the femur (through the fractured acetabulum) may be difficult or impossible to reduce. Three methods—continuous traction, manipulative reduction under anesthesia and open operation—are used to reduce these fractures. In 47 cases there were 10 deaths. In only one case was an open operation performed and the result was excellent with a shortening of only 1 centimeter and about 10 per cent permanent disability. An abstract of each of the 306 cases is appended with about 100 reproductions of roentgenograms and tracings of many others.

The author deserves great credit for his painstaking work.

LOWIN W. RYERSON

EDWIN W. RYERSON

The group five of part 3 B of Section V *Handbuch der biologischen Arbeitsmethoden*<sup>1</sup> there are four articles. The first on Secretins by Adolf Bichel and Carl von Eweyk is short and inadequate and contains no reference to work since 1923. The second on Morphological and Experimental In-

vestigation of the Ovary by Johannes Hett is complete and thorough and will be useful to the investigator and the physician who desire to know the experimental literature on this subject. The third, on The Method of Investigation of the Isolated Endocrine Glands, is excellent and contains eight diagrams and considerable detail on technique. It will be valuable to the investigator who desires to study isolated organs. The fourth article, on "The Preparation and Evaluation of the Parathyroid Hormone" by J. B. Collip summarizes our knowledge of these glands and evaluates adequately their rôle in the animal organism.

A C I

**I**T is not so many years ago that the medical world was apprised of a new movement in medicine—teamwork. In the beginning only a limited number of the departments of medicine—for instance, general surgery and internal medicine—were interested in such co-operation. Today, however, almost all departments of medicine co operate in making diagnoses and treating patients. Urology is not an exception for we find the urologist and roentgenologist working together to secure more accurate and positive diagnoses. That this co operation has been of special benefit to patients goes without saying and that both urologist and roentgenologist have benefited thereby is an important milestone in the development of both specialties.

Young and Waters in their section in the *Annals of Roentgenology*<sup>2</sup> describe the various technical developments in urological roentgenology in a most thorough manner. The different types of cystoscopic tables and cystoscopes are adequately considered. The same can truthfully be said of the methods of Roentgen diagnosis inclusive of renal fluoroscopy, the use of the roentgen ray films at the time of operation, stereoscopy, ureterography, cystography, diverticulography, vesiculography, ampullography, vasography, and urethrography. Excellent sections on topography, anatomy, and physiology of the urinary tract are given, special emphasis being placed on the frequency and surgical importance of renal anomalies.

The results of obstructive conditions as they affect the kidney have a chapter of their own, ureteral reflux, hydronephrosis and stricture of the urethra being especially dwelt upon to illustrate the complications which may ensue from such obstructions. The value of roentgenology in the diagnosis of obstructions at the vesical orifice—prostatic hypertrophy and contractures—as well as the diagnosis of the valves of the posterior urethra and the various roentgen ray data obtained in the urogenital infections are not only outlined but are so carefully explained that the reader cannot but profit from a close study of the salient points which are emphasized.

<sup>1</sup> *ANNALS OF ROENTGENOLOGY: A SERIES OF MONOGRAPHIC ATLASSES*  
 Edited by James T. Case, M.D., Vol. vi—*Orologic & Roentgenology*  
 by Hugh H. Young, M.D., and Charles A. Waters, M.D. New York  
 Paul B. Hoeber, Inc. 1918

treatment and radiation are both discussed. It is interesting to note that there are 5 contributions to cancer of the lung. Naturally chemotherapy by intravenous lead received its fair attention in 14 contributions. Bell, who delivered a paper apparently did not publish it in this volume. Just as the papers on Cancer Research registered the fact that Gye's work and conclusions have not been confirmed so the papers on lead treatment emphasize the fact that the curative value of intravenous lead has been found to be practically nil. The conclusions of Bell were not confirmed.

This book should be in every medical library in this country, and every student of cancer, whether research worker, pathologist, surgeon, or roentgenologist should read carefully every one of the articles because they record pretty faithfully the opinion of cancer students throughout the world up to 1928. This book should be read with the Proceedings of the Lake Mohonk Convention which were published by the Surgical Publishing Company of Chicago in 1927 and may be obtained through them or through the American Society for the Control of Cancer in New York.

The conclusions that impressed me most are that the British Empire Cancer Campaign has a larger representation of the British government and a larger active representation from the British Empire and the British Dominions than the American Society for the Control of Cancer. There are at least 100 names on the Grand Council of the British Empire Cancer Campaign while in the American Society for the Control of Cancer there is now practically only one representative of the United States Government—an Assistant Surgeon General of the United States Public Health Service. It is my opinion, however, with which some of my colleagues do not agree, that the American Society for the Control of Cancer has done more for the actual cure of cancer than any other agency in the civilized world. The greatest criticism of the London Conference is their failure to recognize that the people must be directly educated. All cancer students throughout the world seem to agree that the cure of cancer depends upon the reduction of the time between the first symptom and the treatment, whether it is surgery or radiation. In spite of this the chief interest of the medical profession is in the treatment of the late and usually hopeless stage of cancer. It is quite true that today the majority of cancer patients come under observation in this late deplorable stage and it is imperative to provide for their treatment with surgery or radiation and to make further experimental attacks like Bell's intravenous lead and other therapeutic agents.

In this country we have demonstrated that the people can be actually informed and influenced to act at once. In some clinics operability has been reduced from more than 50 to less than 10 per cent. The actual cures from the operative treatment of cancer have increased from less than 10 to more than 60 per cent. In some clinics the percentage of

precancerous lesions, especially of the mouth and skin, have increased from less than 5 to more than 65 per cent.

The medical profession throughout the civilized world must be influenced to realize the importance of the educational efforts and must aid the smaller group in creating a public opinion which will bring more financial aid to education.

The next disappointing fact shown in both the American and the London Conferences is the small number of educated men and women who are able to devote their full time to cancer research in proper environment and with full financial backing. Cancer will never be controlled by education alone with the therapeutic agents we have today. Through enlarged organized financed medical research laboratories there must be found the cause, prevention, and cure of cancer.

Nevertheless these two conferences in New York in 1926 and in London in 1928, demonstrate that at the present moment the mysterious disease called cancer is gaining the attention of not only the scientific world, but of the great mass of people. An educated Mexican woman said to me a few days ago: Five years ago none in Mexico knew anything about cancer. Today the people are getting their correct information. In the *New York Times* of Sunday May 5, 1929, there is the statement: 'Everybody knows what cancer is.'

Those who read these two books should also inform themselves on what is being done by the Commonwealth of Massachusetts through its Department of Health, and I refer you to the *American Journal of Public Health* and the *Nation's Health* for April 1928, to an article by Dr. Herbert L. Lom.

JOSEPH COLE BLOODGOOD

**BEITRÄGE zur Kenntnis der Beckenbrüche und Beckenluxationen** is a monograph in German by a Swedish surgeon. It was written at the suggestion of Prof. Gunnar Nyström and is the only work of such size and completeness since the introduction of the roentgen ray. The author's own material is drawn from 504 of the largest hospitals in Sweden and comprises 306 cases of fracture of the pelvis observed during a period of 16 years from 1911 to 1926. The largest number of cases previously investigated by any author is 102.

The incidence of pelvic fractures is greater during the years from 20 to 60 and the large majority occurred in automobile, motorcycle and street car accidents.

Fractures not involving the pelvic ring included 47 iliac, 20 sacral, 13 ischial and coccygeal and 4 of the ring of the acetabulum. Fractures involving the pelvic ring included 106 pubic and ischial, 52 anterior and posterior, 4 posterior alone, and 47 through acetabulum.

1. BEITRÄGE ZUR KENNNTNIS DER BECKENBRÜCHE UND BECKEN LUXATIONEN. KLINISCHES UND RÖNTGENOLOGISCHES UNTERSUCHUNGEN ÜBER DIE ANATOMIE, DEN VERLAUF, DIE KOMPLIKATIONEN, DIE BEHANDLUNG UND DIE PROGNOSE. By AND. H. WESTERBOM. Uppsala, Almqvist & Wikells 1928.

The anatomy and mechanism of the various fractures are well described. Treatment of fractures of the ilium should be conservative even though considerable displacement is present. Lambotte is the most ardent advocate of open operative replacement and fixation but the author's cases show that this is rarely necessary. Fractures between the crest and the body of the ilium heal in all cases without operation and need only be treated by rest in bed for 3 or 4 weeks.

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Fractures of the pelvic ring are more common and more interesting than those not involving the ring. Two hundred and nine cases are included in the author's series. The entire pelvis should be included in the X-ray examination of all suspected cases.

Separation of the symphysis pubis of more than 15 millimeters is certain to involve damage to the capsule or the ligaments of the sacro iliac joints. Forty millimeters separation will involve a severe tearing apart of at least one sacro iliac joint.

Central dislocation of the head of the femur (through the fractured acetabulum) may be difficult or impossible to reduce. Three methods—continuous traction, manipulative reduction under anesthesia and open operation—are used to reduce these fractures. In 47 cases there were 10 deaths. In only one case was an open operation performed and the result was excellent with a shortening of only 1 centimeter and about 12 per cent permanent disability. An abstract of each of the 306 cases is appended with about 100 reproductions of roentgenograms and tracings of many others.

The author deserves great credit for his painstaking work.

EDWIN W. RYERSON

A group five of part 3 B of Section V *Handbuch der biologischen Arbeitsmethoden*<sup>1</sup> there are four articles. The first on "Secretins" by Adolf Bichel and Carl von Eweik is short and inadequate and contains no reference to work since 1923. The second on "Morphological and Experimental In-

vestigation of the Ovary" by Johannes Hett, is complete and thorough and will be useful to the investigator and the physician who desire to know the experimental literature on this subject. The third, on "The Method of Investigation of the Isolated Endocrine Glands" is excellent and contains eight diagrams and considerable detail on technique. It will be valuable to the investigator who desires to study isolated organs. The fourth article, on "The Preparation and Evaluation of the Parathyroid Hormone" by J. B. Collip, summarizes our knowledge of these glands and evaluates adequately their rôle in the animal organism.

A. C. I.

It is not so many years ago that the medical world was appraised of a new movement in medicine—teamwork. In the beginning only a limited number of the departments of medicine—for instance general surgery and internal medicine—were interested in such co-operation. Today, however, almost all departments of medicine co-operate in making diagnoses and treating patients. Urology is not an exception for we find the urologist and roentgenologist working together to secure more accurate and positive diagnoses. That this co-operation has been of special benefit to patients goes without saying and that both urologist and roentgenologist have benefited thereby is an important milestone in the development of both specialties.

Young and Waters in their section in the *Annals of Roentgenology*<sup>2</sup> describe the various technical developments in urological roentgenology in a most thorough manner. The different types of cystoscopic tables and cystoscopes are adequately considered. The same can truthfully be said of the methods of Roentgen diagnosis inclusive of renal fluoroscopy, the use of the roentgen ray films at the time of operation, stereoscopy, ureterography, cystography, diverticulography, vesiculography, ampuulography, vasography and urethrography. Excellent sections on topography, anatomy and physiology of the urinary tract are given special emphasis being placed on the frequency and surgical importance of renal anomalies.

The results of obstructive conditions as they affect the kidney have a chapter of their own, ureteral reflux, hydronephrosis and stricture of the urethra being especially dwelt upon to illustrate the complications which may ensue from such obstructions. The value of roentgenology in the diagnosis of obstructions at the vesical orifice—prostatic hypertrophy and contractures—as well as the diagnosis of the valves of the posterior urethra and the various roentgen ray data obtained in the urogenital infections are not only outlined but are so carefully explained that the reader cannot but profit from a close study of the salient points which are emphasized.

<sup>1</sup> *ANNALS OF ROENTGENOLOGY. A SERIES OF MONOGRAPHIC ATLASSES* Edited by James T. Case, M.D., A.B., A.C.—Urological Roentgenology by Hugh H. Young, M.D., and Charles A. Waters, M.D. New York: Paul B. Hoeber, Inc. 1928.

<sup>2</sup> *HANDBUCH DER BIOLOGISCHEN ARBEITSMETHODEN*. Edited by Geh. Med. Rat. Prof. Dr. Emil Abderhalden. 1. Abt.: Methoden zum Studium der Funktion der Organe. 2. Abt.: Methoden zum Studium der Zellfunktion. Berlin und Vienna: C. G. L. and Schwarzenberg, 1928.

Of great interest to every urologist is the subject of tuberculosis and many illustrations are given to show the various types of roentgenological data obtained in this group of cases.

A subject that is presented in detail and with profuse illustrations is urinary lithiasis, a matter of great importance in the work of both urologist and roentgenologist.

In the diagnosis of tumors, whether of the kidneys or bladder, the roentgenologist is the one who can give the desired information so that no mistakes are made, especially in bladder tumors, as the data obtained by cystoscopy greatly strengthened by stereoscopic cystograms.

This monograph is distinctive in that the many illustrations which are exceedingly well executed are so carefully arranged that the text is greatly illuminated and the real purpose of the publication is carried out. In short, a diagnostic guide is supplied that cannot fail to enlighten the roentgenologist in regard to the significance of the various diseases of the urinary tract, so that in the team work already mentioned his rank will be of the same importance as that of the urologist.

II I A

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There are a number of serious criticisms to be made of sections that appear to the reviewer to be fundamentally wrong. The first one concerns the chapter on inguinal hernia, which is by no means impressive. It may save time and space to limit the discussion of an operative procedure to one technique, but the Bassini operation cannot be satisfactorily applied to all so called "simple" inguinal hernias. The use of muscle in the repair of any abdominal hernia is generally regarded as a debatable procedure. The suggestion to use even a small rubber drain to control oozing following inguinal herniotomy would find little acceptance by surgeons.

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There are hundreds of illustrations in the text but the majority are entirely too sketchy to serve any useful purpose. This applies particularly to the chapters on stomach and colon.

By way of summary it may be said that the author has an extensive compilation of material but lack of care and accuracy in its presentation make it of relatively slight teaching or reference value.

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RECENT ADVANCES IN SURGERY. By W. H. Keen, Obit. M. A. M. D. M. Ch. (Dr. J. F. R. C. S. (E. & J. Philadelphia P. Blakist. & S. N. & Company 1928).

DIA. VONTSCHER UND DER APT. SCHER. IRTOPFER UND DEREN VERBETTER. N. CHIRURGIE. Edited by Prof. Dr. J. Schwabe. V. J. H. Leipzig. Geo. G. Thieme 1928.

<sup>1</sup> PRACTICAL SURGERY OF THE ABDOMEN. By George H. J. J. M. D. With a foreword by W. Wayne Babcock, M. D. Vols. 1 and 2. Philadelphia F. A. Davis & Company 1928.

monograph of some 130 pages replete with illustrations and written in an authoritative and exhaustive style. It is the best piece of writing on the subject that has come to the reviewer's attention. It contains most valuable information for the surgeon no less than for the general practitioner. In the same volume one finds a contribution by Kirschner on peritonitis and by Holbaum on hernia. Both, while not on the same plane of excellence as Payr's contribution, are well written and abreast of the most advanced conceptions.

The contents of the last volume comprise a chapter on the diseases of the diaphragm, on internal hernia and on the intestinal canal by Heller, on the diseases of stomach and duodenum by Holbaum and on the intestinal obstruction by Kleinschmidt. They are well written and contain a great deal of useful and practical information and that despite the fact that some of them deal with rather unusual conditions, such as the diaphragmatic hernia, Meckel's diverticulum and internal herniae. Particularly

well written is the chapter by Kleinschmidt on ileus. It is on a par with the already mentioned classical contribution of Payr on appendicitis. Such contributions derive their value from the fact that the statistics on ileus will show little improvement until the general practitioner learns to recognize early the symptoms of this condition. The symptomatology of the condition is treated in a most masterly manner. Running through the entire discussion, like a red line, is the admonition 'operate early'.

To those who read German the volume offers authoritative and well arranged information of value to both the general practitioner and the surgeon. The subject matter is of the most practical character dealing with the diagnosis and treatment. The practical character of the information offered will undoubtedly help greatly to improve our means of early diagnosis and therefore our operative results. The desirability of a similar work written in English appears logical.

C. GEORGE HALPERIN

## BOOKS RECEIVED

Books received are acknowledged in this department and such acknowledgment must be regarded as a sufficient return for the courtesy of the sender. Selections will be made for review in the interests of our readers and as space permits.

**PHYSICAL THERAPEUTIC TECHNIC** By Frank Butler Cranger A.B. M.D. With a Foreword by William D. McVee M.D. Philadelphia and London: W. B. Saunders Company, 1920.

**PRINCIPLES OF PATHOLOGY FOR PRACTITIONERS AND STUDENTS** By H. D. Arcy Power M.D. FRPS and William W. Hala M.D. New York and London: D. Appleton & Company, 1920.

**THE MOBILIZATION OF ANKYLOSED JOINTS** By ARTHUR FLASTY By W. Russell MacAusland M.D. and Andrew R. MacAusland M.D. Philadelphia: Lea & Febiger, 1920.

**LEHRBUCH DER DIAGNOSTISCHEN UND OPERATIVEN GYNÄKOLOGIE** By Dr. Eugen Joseph Berlin Julius Springer, 1920.

**A SHORTER SURGERY: A PRACTICAL MANUAL FOR SENIOR STUDENTS** By R. J. McNeill Love New York: William Wood & Company, 1920.

**PRACTICAL CHIROPODY** By E. G. V. Runtig I.T.S. Ch. St. Louis: C. V. Mosby Company, 1920.

**DISEASES OF THE THYROID GLAND** By Arthur I. Hertler M.D. With a Chapter on Hospital Management of Goiter Patients. By Victor I. Cheky M.D. 2d ed. St. Louis: C. V. Mosby Company, 1920.

**DISEASES AND DEFORMITIES OF THE SPINE AND THORAX** By Arthur Steindler M.D. F.A.C.S. St. Louis: C. V. Mosby Company, 1920.

**BIOLOGIE UND PATHOLOGIE DES WEIBES EIN HANDBUCH DER FRAUENHEILKUNDE UND GEBURTSHILFE** By Josef Hallan and Ludwig Seitz. Lieferung 43. Berlin and Vienna: Urban & Schwarzenberg, 1920.

**PRACTICE OF SURGERY** Edited by Dean Lewis M.D. 2d ed. Vol. 11: Thyroid Gland, Parathyroid, Stomach

Duodenum, Gastro-Enterostomy, Spleen. Hagerstown: Md. W. F. Prior Company, Inc., 1920.

**MORTALITY STATISTICS 1926** Part 1. Department of Commerce, Bureau of the Census, Washington, United States Government Printing Office, 1929.

**THE INTERNATIONAL MEDICAL ANNUAL: A YEAR BOOK OF TREATMENT AND PRACTITIONER'S INDEX** Forty-Seventh Year. New York: William Wood and Company, 1920.

**REFLECTIONS AND OPERATIONS** By Sir John O'Connor K.B.E. M.A. M.D. (Dub. Univ.) With a Foreword by Herbert J. Pater on C.B.E. M.C. M.D. (Camb.) F.R.C.S. (Eng.) London: Baillière Tindall and Cox, 1920.

**PROGRESSIVE RELAXATION: A PHYSIOLOGICAL AND CLINICAL INVESTIGATION OF MUSCULAR STATES AND THEIR SIGNIFICANCE IN PSYCHOLOGY AND MEDICAL PRACTICE** By Edmund Jacobson A.M. Th.D. M.D. Chicago: University of Chicago Press, 1920.

**THE MEDICAL CLINICS OF NORTH AMERICA** Vol. 12, No. 6. Index Number. Philadelphia and London: W. B. Saunders Company, 1920.

**SURGICAL PATHOLOGY** By William Boyd M.D. M.R.C.I. (Ed.) Dapt. Psych. F.R.S. (Can.) 2d ed. Philadelphia and London: W. B. Saunders Company, 1920.

**THERAPY OF PERSONAL INFLUENCE: AN A B C OF TREATMENT BY PERSONAL INFLUENCE, SUGGESTION, MEDICAL HYPNOSIS AND PSYCHOMAGNETIC METHODS** By Edwin Hopewell Ash M.D. London: Published privately, 1920.

**ANNUAL REPRINT OF THE REPORTS OF THE COUNCIL ON PHARMACY AND CHEMISTRY OF THE AMERICAN MEDICAL ASSOCIATION FOR 1928** Chicago: American Medical Association, 1929.

**CHRONIC (NON-TUBERCULOUS) ARTERITIS: PATHOLOGY AND PRINCIPLES OF MODERN TREATMENT** By A. G. Timbrell F.R.C.S. (Eng.) New York: The MacMillan Company, 1929.



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<sup>3</sup> PRACTICAL SURGERY OF THE ABDOMEN. By George H. Jull. M. D. Vol. 1. Second by W. Wayne Babcock. M. D. Vol. 2. Phil. D. L. P. D. I. Company 1928.

same evening Dr D P D Wilkie professor of surgery in the University of Edinburgh, will deliver the Murphy oration on surgery. Programs for scientific meetings on Tuesday, Wednesday, and Thursday evenings are in course of preparation, at which distinguished surgeons from the United States and Canada and eminent surgeons from abroad will present papers dealing with surgical subjects of present day importance. On Friday evening at the annual Convocation of the College, the 1929 class of candidates for Fellowship in the College will be received.

A program has been outlined for a conference on traumatic surgery on Friday with sessions both morning and afternoon. Leaders in industry, education, and labor, together with representatives of indemnity companies, surgeons, and hospital administrators will contribute to the discussion. The chairman of the committee on traumatic surgery will report on the work of the committee in recent years and outline future activities in this department of the College work.

An interesting program of papers, round table conferences and practical demonstrations dealing with many of the problems related to the hospital standardization program of the College and hospital efficiency in general is being prepared for the annual hospital conference which opens at 10 o'clock on Monday morning in the grand ballroom of the Stevens Hotel. The conference will hold sessions on Monday afternoon and on Tuesday and Wednesday mornings and afternoons. The program is planned to interest surgeons, hospital trustees, executives, nurses and hospital personnel generally, and the invitation to attend is extended to all persons interested in the hospital field.

At the annual meeting of the College to be held on Thursday afternoon, beginning at 2 o'clock, formal reports of the activities of the College will be presented by the officers and several standing committees. The major portion of the afternoon will be devoted to a symposium on cancer with contributions by distinguished surgeons and research workers dealing with various aspects of the problem.

General headquarters for the Congress will be established at the Stevens Hotel located on Michigan Avenue between Seventh and Eighth Streets where the grand ballroom and many other large rooms have been reserved for the exclusive use of the Congress for scientific meetings, conferences, registration and ticket bureaus, bulletin boards, exhibits, executive offices, etc. The grand ballroom will be utilized for the evening meetings, hospital conferences, and other large gatherings.

#### LIMITED ATTENDANCE

Attendance at the Chicago session will be limited to a number that can be comfortably accommodated at the clinics, the limit of attendance being based upon the result of a survey of the amphitheaters, operating rooms, and laboratories in the hospitals and medical schools to determine their capacity for accommodating visitors. Under this plan it will be necessary for those who wish to attend to register in advance.

Attendance at all clinics and demonstrations will be controlled by means of special clinic tickets, which plan provides an efficient means for the distribution of the visiting surgeons among the several clinics, and insures against overcrowding as the number of tickets issued for any clinic will be limited to the capacity of the room in which that clinic will be given.

#### REGISTRATION FEE

A registration fee of \$5.00 is required of each surgeon attending the annual Clinical Congress, such fees providing the funds with which to meet the expenses of the meeting. To each surgeon registering in advance a formal receipt for the registration fee is issued which receipt is to be exchanged for a general admission card upon his registration at headquarters. This card which is non transferable, must be presented to secure clinic tickets and admission to the evening meetings.

#### REDUCED RAILWAY FARES

The railways of the United States and Canada have authorized reduced fares on account of the Chicago session of the Clinical Congress so that the total fare for the round trip will be one and one half the ordinary first class one way fare. To take advantage of the reduced rates it is necessary to pay the full one way fare to Chicago, procuring from the ticket agent when purchasing ticket a 'convention certificate' which certificate is to be deposited at headquarters for the use of a special agent of the railways. Upon presentation of a visé certificate to the ticket agent in Chicago not later than October 30th a ticket for the return journey by the same route as traveled to Chicago may be purchased at one half the regular fare.

In the eastern, central, and southern states and eastern provinces of Canada tickets may be purchased between October 10th and 18th, in south western and western states between October 9th and 17th and in the far western states and western provinces of Canada between October 6th and 14th. The return journey from Chicago must be begun not later than October 30th.

# CLINICAL CONGRESS OF AMERICAN COLLEGE OF SURGEONS

FRANKLIN H. MARTIN *Chicago President*

MERRITTE W. IRELAND *Washington President Elect*

## CHICAGO EXECUTIVE COMMITTEE

HERMAN I. KRETSCHMER <i>Chairman</i>	LOYAL DAVIS, <i>Secretary</i>
JOSEPH C. BECK	PHILIP H. KRETSCHMER
ARTHUR H. CURTIS	EDWIN MCGINNIS
VERNON C. DAVID	DALLAS B. PREMISTER
CARL B. DAVIS	ALFRED A. STRAUSS

## CHICAGO SURGEONS PLAN FOR THE 1929 CLINICAL CONGRESS

CHICAGO'S popularity as a clinical center will be evidenced in the plans for the nineteenth annual Clinical Congress of the American College of Surgeons to be held in Chicago October 14-18. The number of advance registrations already received following the publication of the first notice of plans for the Congress strongly indicates an unusually large attendance at this year's meeting.

Under the leadership of a strong and representative committee of clinicians the surgeons of Chicago are planning a program of clinics and demonstrations for the entertainment of Fellows of the College and their guests that will completely portray the clinical activities of Chicago in all departments of surgery including general surgery, gynecology, obstetrics, orthopedics, urology, and surgery of the eye, ear, nose, throat, and mouth.

The clinical program being prepared schedules operative clinics and demonstrations in the hospitals for Monday afternoon beginning at 2 o'clock and for each morning and afternoon of the following four days. A preliminary program is to be published in the next issue of *SURGERY GYNECOLOGY AND OBSTETRICS*.

Clinics and demonstrations will be given daily at the following hospitals: Alexian Brothers, Augustana, Billings Memorial, Chicago Memorial, Children's Memorial, Columbus Cook County, Eye, Ear, Nose, and Throat, Evangelical Deaconess, Garfield Park, Grant, Hennrich, Illinois Central, Illinois Eye and Ear Infirmary, Illinois Masonic, Lake View, Lutheran Deaconess, Lutheran Memorial, Lying In, Mercy, Mt. Sinai, Munic-

ipal Tuberculosis Sanitarium, John B. Murphy, North Chicago, Passavant Memorial, Post Graduate, Presbyterian, Ravenswood, Michael Reese Research and Educational, St. Anthony's, St. Bernard's, St. Joseph's, St. Luke's, St. Mary's, Shriners', South Shore, University, Washington Boulevard, Washington Park, Wesley Memorial, West Side. The program will also include demonstrations in the laboratories of the medical schools of Northwestern University, University of Chicago, Rush Medical College, University of Illinois, Loyola University.

A special feature of the clinical program will be a series of clinical demonstrations at headquarters at the Stevens Hotel on Tuesday and Wednesday afternoons, from 2 to 5 o'clock, presented by outstanding surgeons of the American continent.

The subcommittee in charge of the section on surgery of the eye, ear, nose, and throat, in addition to arranging for clinics and demonstrations in the hospitals for each morning and afternoon of the Congress, is arranging for two evening scientific meetings—on Tuesday evening a series of papers dealing with surgery of the eye, and on Wednesday evening papers treating of surgery of the ear, nose and throat. Complete details are to be published in an early issue.

The Executive Committee of the Congress is preparing programs for a series of evening meetings. At the Presidential Meeting on Monday evening in the ballroom of the Stevens Hotel the president elect, Major General Merritte W. Ireland, surgeon general of the army, will be inaugurated and deliver the annual address. On the

# SURGERY, GYNECOLOGY AND OBSTETRICS

AN INTERNATIONAL MAGAZINE, PUBLISHED MONTHLY

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## HERNIA THROUGH THE OESOPHAGEAL ORIFICE OF THE DIAPHRAGM<sup>1</sup>

EDWARD F. RICHARDSON, A.B., M.D., F.A.C.S., BOSTON, MASSACHUSETTS  
From the Surgical Services of the Massachusetts General Hospital

**H**ERNIA through the diaphragm formerly recognized only at autopsy or on the operating table is becoming diagnosed more and more frequently by means of X-ray examinations. Thus an abnormal condition, formerly brought to attention through the accident of strangulation or intestinal obstruction, becomes available for the study of symptomatology in the absence of acute emergencies.

If the diaphragm were as accessible for observation as the anterior abdominal wall, varieties of diaphragmatic hernia with greater individual peculiarities than those which distinguish the inguinal, femoral and umbilical types would have long been recognized. At present, by means of X-ray examinations this separation of diaphragmatic herniae into varieties of differing prognostic importance to the patient is beginning to be possible. In this way hernia through the oesophageal orifice may be distinguished with relative certainty.

Diaphragmatic hernia may be congenital or acquired. If acquired it may be traumatic or non-traumatic. It may be a true hernia, contained within a sac lined with peritoneum, the contents of which are thus limited from contact with other structures; or it may be a false hernia with the viscera composing it passing directly into the pleural cavity. While the presence or absence of a sac may

be extremely difficult to demonstrate without operation, it is more than an academic question. It gives a suggestion in regard to etiology. Congenital hernia when due to an actual failure of development of part of the diaphragm are false. The same is true of traumatic hernia due to direct wounding of the diaphragm. These varieties occur with preponderating frequency on the left side. The presence of a sac not only limits somewhat the protrusion of abdominal viscera into the thorax but suggests a slowly developing hernia at times congenital in origin or possibly secondary to indirect violence but characteristically occurring in hernia of the non-traumatic acquired type. These true herniae have a tendency to occur at certain well defined weak areas in the diaphragm. The chief in importance are the oesophageal orifice, the foramina of Morgagni, deficiencies in the diaphragmatic muscle on either side of the ensiform cartilage, through which the deep epigastric vessels pass, and the foramina of Bochdalek, gaps occurring between the costal and lumbar muscular slips on either side in the embryo a definite opening, the hiatus pleuroperitonealis.

Diaphragmatic hernia in general is characterized by variable and indefinite symptoms or by a complete lack of symptoms, and by sudden attacks of strangulation and intestinal obstruction. Definite physical find

<sup>1</sup>Read before the Southern Surgical Association, December 11, 1928.

The reduction in fares does not apply to Pullman fares nor to excess fares charged for passage on certain trains. Local railroad ticket agents will supply detailed information with regard to dates of sale rates routes, etc. Stop-overs on both the going and return journeys may be had within certain limits.

Full fare must be paid from starting point to Chicago, and it is essential that a 'convention certificate' be obtained from the agent from whom the ticket is purchased. These certificates are to be signed by the general manager of the Clinical Congress and viséd by a special railroad agent in Chicago during the meeting. No reduction in railroad fares can be secured except in compliance with the regulations outlined and within the dates specified. It is important to note that the return trip must be made by the same route as that used to Chicago and that the certificate must be presented during the meeting and return ticket purchased and used not later than October 30th.

It will be noted that the arrangement outlined above extending the return limit to October 30th allows for an additional twelve days following the Clinical Congress that may be devoted to visiting other clinical centers in the middle west.

An exception to the above arrangement is to be noted in the case of persons traveling from points on the Pacific Coast and certain western states and British Columbia, who will be able to purchase round trip summer excursion tickets which will be on sale up to and including September 30th with a final return limit of October 31st. The summer

excursion fare is somewhat lower than the convention fare mentioned above, but is available only in certain of the far western states and British Columbia. Tickets sold at summer excursion rates permit traveling to Chicago via one direct route and returning via another direct route with liberal stop over privileges.

#### CHICAGO HOTELS AND THEIR RATES

In recent years a number of fine large hotels have been built in Chicago among which is the Stevens with its 3000 guest rooms. Ample first class hotel facilities are available many of the hotels being located within short walking distance of the headquarters hotel.

	Minimum Rates with Bath	
	Single Room	Double Room
Auditorium Michigan Ave and Congress St	\$3.50	\$5.00
Belmont 3100 Sheridan Road	4.00	5.00
Bismarck 175 W. Randolph St	3.50	5.00
Blackstone Michigan Ave and East 7th St	5.00	10.00
Chicago Beach Hyde Park Blvd at the Lake	5.00	5.00
Congress Michigan Ave and Congress St	4.00	6.00
Drake Michigan Ave and Walton Place	5.00	6.00
Edgewater Beach 5340 Sheridan Road	4.00	6.00
Fort Dearborn Van Buren and LaSalle Sts	1.95	3.00
Great Northern Jackson Blvd and Dearborn	3.50	4.50
Knickerbocker Walton Place and Michigan	3.00	5.00
Lake Shore Drive 181 Lake Shore Drive	5.00	7.00
LaSalle LaSalle and Madison Sts	3.00	4.50
Morrison Clark and Madison Sts	2.50	5.00
Palmer Monroe and State Sts	4.00	7.00
Parkway 2100 I. Lincoln Park West	5.00	7.00
Pearson St. Clair and Pearson Sts	3.50	5.00
Sherman Clark and Randolph Sts	3.00	4.00
Stevens Michigan Ave and 7th St	3.50	6.00
Webster I. Lincoln Park West at Webster Ave	3.00	5.00

to the degree of intra abdominal pressure and of gastric tension. On this account the hernial sac is rarely visible in films of the thorax unless barium is administered. Even if barium is given, the hernia will probably not fill if examination is carried out in the upright position only. At autopsy the hernial pouch is likely to be overlooked, unless it happens to contain stomach at the time.

Morrison's results depend on special skill in the examination of this region and on a definite search for a hernia, the presence of which he is able to suspect through the recognition of suggestive symptoms. He observed a gas bubble above the diaphragm in only 4 of the 42 cases. He states that in nearly all hernia cases, there is a delay in the oesophagus with slight dilatation. After the barium is ingested an attempt to fill the hernia by pressure is only occasionally successful. Fluoroscopic examination is carried out on the horizontal table in the supine position. In all his series, the cardio oesophageal opening was patent. The hernia will usually fill, if present, on turning the patient into the left oblique position and directing him to take a long breath. At times, turning the patient into other positions is necessary. The Trendelenburg posture is sometimes helpful.

We may conclude, therefore, that hernia of the stomach through the oesophageal orifice of the diaphragm is not an extreme rarity and is the most common form of acquired diaphragmatic hernia. This type of hernia will probably be shown with increasing frequency on X ray examinations, particularly if a search is made for it.

What should be our attitude when such a hernia is shown to exist? This will be modified of course by the contents of the sac. If X ray examination by barium meal and enema shows it to contain stomach only strangulation is improbable, and the risk to the individual is not great. Operative treatment therefore is not necessary as a life saving measure and will depend on the severity of the symptoms which accompany the hernia.

Since 1922 I have operated on 5 cases of hernia through the oesophageal orifice in which the diagnosis was made previous to

operation. The symptomatology and treatment may perhaps be better discussed after presenting these cases.

**CASE 1.** A single woman of 53 entered the hospital, October 4, 1922 through the emergency ward on account of an acute attack of abdominal pain. For about 20 years she had suffered from "indigestion" characterized by irregular attacks of gastric distress coming on an hour or two after eating—belching pyrosis and occasional attacks of sharp pain radiating through to the back accompanied by nausea and vomiting. She had never been jaundiced. Five days previously she was waked at night by severe pain in the epigastrium radiating to the back temporarily relieved by morphia but recurring next day and confining her to bed. This attack was associated with anorexia and slight fever. The remainder of her personal history was not important. There was no story of difficulty in swallowing.

Examination showed a slightly jaundiced woman in good general condition. In the right upper quadrant of the abdomen local tenderness and definite spasm were present. Temperature, pulse rate and leucocyte count were normal.

The diagnosis was subsiding acute cholecystitis. On account of the long history of digestive disturbance, a gastro intestinal X ray was taken. This showed no organic lesion in the stomach, duodenum or small bowel. When the patient was lying on her back on deep inspiration a pouch like bulging was seen just above the cardia apparently above the diaphragm. It was more pronounced while the patient was drinking. The appearance suggested either an oesophageal pouch or a small hernia of a portion of the stomach through the oesophageal opening.

Operation in this case was clearly indicated by the duration of the symptoms and the evidence of acute cholecystitis. Operation was performed under ether on October 19, 1922, through a right rectus incision over the gall bladder. The gall bladder was found thick walled and slightly edematous. No gall stones were felt. The head of the pancreas was somewhat thickened. There were no stones in the common duct. At the oesophageal orifice there was a purse like hernia sac about 1.5 inches in diameter with a ring of about 1 inch. The stomach and duodenum were negative. The abdomen was otherwise negative. A cholecystectomy and an appendectomy were done.

The patient made an uninterrupted postoperative recovery. When seen a year later she had been working constantly since 5 weeks after the operation. She had been completely relieved of her digestive disturbances and abdominal pain.

On October 11, 1928, patient stated that she was very well and was able to eat anything without distress. However direct questioning brought out that occasionally she had regurgitation with a taste of food occurring during the day or sometimes at

ings suggesting the condition are unusual. Rarely in large hernia the presence in the chest of tympany or dullness absent or diminished breath sounds, displacement of the heart, splashing or the gurgling of peristalsis, may suggest the diagnosis. Or a hernia may be discovered accidentally in the course of a  $\lambda$  ray examination for other conditions, either through the presence of gas, or fluid containing structures above the diaphragm in plates of the chest, or of barium filled viscera during the course of gastro intestinal examinations. The final demonstration of diaphragmatic hernia depends on the use of barium, either by mouth or by enema. In this way not only the size and position of the hernia may be shown but what hollow viscera it contains. The only conditions likely to be confused with it are eventration of the diaphragm and thoracic stomach. In the former condition, the thinned and relaxed diaphragm is crowded up into the thorax permitting the abdominal viscera to rise. Diagnosis depends on the  $\lambda$  ray demonstration of the thinned and high arched diaphragm separating the abdominal viscera from the thorax. In thoracic stomach the diaphragm is in its normal position, the stomach, however, is partially or completely intrathoracic and the oesophagus is correspondingly short.

All the abdominal viscera, except organs situated in the pelvis, have at one time or another been found above the diaphragm in a hernia. The important structures from a surgical point of view which may be found there are the stomach, the colon, particularly its transverse part, and the small intestine. The stomach, although it may become incarcerated, in part at least, above the diaphragm, is hardly likely to become strangulated. Intestine, however may become obstructed and strangulated with all the dangers which go with it. The urgency of operation in diaphragmatic hernia, in the absence of obstruction, therefore, depends on the contents of the hernia, which can be shown on  $\lambda$  ray examination. If the hernia contains stomach only, the advisability of operation depends on the symptoms produced rather than on the dangers to the individual

Hernia through the oesophageal orifice of the diaphragm is commonly considered a rare condition. Hedblom states that in 163 cases operated upon since 1907, the hernia was at the oesophageal orifice in 33. Woolsey found that of 106 cases occurring in civil life since 1900, hernia at the oesophageal orifice, which he classed as acquired, occurred in 17. Harrington found that in 17 of 51 cases of diaphragmatic hernia at the Mayo Clinic since 1908, the diagnosis of hernia of the cardiac end of the stomach through the oesophageal opening was made by means of the Roentgen ray. He states that this is the most common type of hernia that occurs in adults. In 1924, Morrison reported 42 cases, recognized on  $\lambda$  ray examination in a series of about 3,500 gastric cases studied, or in a little over 1 per cent. A year later Healy summarized 53 cases, varying in size from an English walnut to a grape fruit, from the same office. Morrison (6) now writes me that he has observed over 130 cases. He has seen only one case in which there was a hernia of the bowel as well as the stomach, and in this case he was unable to convince himself that the hernial sac passed through the oesophageal hiatus. He believed that it went through a slit in the diaphragm just to the left. Bevan has reported a case of hernia through the oesophageal opening which contained transverse colon.

Since 1922, I have customarily felt of the oesophageal ring in the diaphragm as a part of exploration of the upper abdomen. It commonly admits the tip of a finger. A pouch admitting two, three, or four fingers is not an unusual finding. While I have no figures to offer my observations confirm those of Morrison in regard to the frequency of this condition.

We have, therefore, the apparent contradiction of a condition for which operation has been rarely performed and yet which may be observed not infrequently on  $\lambda$  ray examination. I believe that this is explainable on the ground that these patients rarely get into serious difficulties. The reason that the hernia is not more frequently found is that the stomach is only occasionally present in the sac, slipping in and out of it, according

stomach was very large. In the region of the pylorus there was a tumor about the size of a lemon firmly adherent to the liver. Regional glands were not enlarged and there was no visible metastasis. The tumor felt like carcinoma, but may have been ulcer. The hernial opening was about 4 centimeters in diameter at the esophageal opening and contained stomach. This was readily delivered and found to consist of the anterior wall of the fundus of the stomach which had rotated to the right and entered the hernial sac. This had brought the spleen very close to the esophageal opening. The opening through the diaphragm was closed by transverse interrupted sutures of chromicized catgut, the lower suture including the peritoneum over the esophagus. The tissues were firm and made a very good closure. A posterior gastro enterostomy was then done.

The report of the postoperative X-ray examination on May 21, 1927, was as follows: Definite mottled opacity at the right base and the right diaphragm is indistinct; also there is some uniform mottled density in the region of the costophrenic angle. Changes suggest an infectious process at the right base with a small amount of fluid. At the present time there is no shadow that suggests a bubble of gas above the diaphragm.

On March 22, 1928, she was re-examined. She had no digestive distress whatever and no trouble with swallowing. Her color was good and her weight 137½ pounds. Examination of the abdomen was negative. She seemed entirely well.

On October 13, 1928, fluoroscopic examination showed the herniation above the diaphragm still present.

The principal complaints in this patient were evidently due to the pyloric obstruction, which, in view of the postoperative course, was secondary to ulcer. I believed that this patient was entirely cured, the finding of a recurrence of the hernia on X-ray examination was a surprise. There were, however, apparently no symptoms referable to the hernia, once the pyloric obstruction had been relieved.

**CASE 3.** A married woman of 64 years entered April 30, 1928, from the Out Patient Department where she had applied for treatment of a vaginal discharge. She also complained of abdominal discomfort. In the course of study, a gastro intestinal X-ray was taken which showed a diaphragmatic hernia.

Fifteen years previously her gall bladder had been removed for cholelithiasis. Following this she was free from abdominal symptoms until 2 years ago when she noticed a dull pain in the left upper quadrant. Immediately after she ate or on exertion, particularly if she leaned forward, the pain



Fig. 2. Case 2. Following a barium meal.

became sharp and severe, radiating through to the back and was sometimes accompanied by vomiting of food recently eaten. Associated with this pain there was a cramp-like knotted feeling of a mass in the left upper abdomen and sometimes gurgling of gas. This symptom, although disagreeable, was not incapacitating and had apparently not affected her general health. There was no difficulty in swallowing. Loss of weight was questionable. She had some dyspnea and precordial pain on exertion with occasional attacks of vertigo. The remainder of her personal and family history was not important.

Examination showed an elderly woman apparently in good general health. Examination of the chest was negative except for a systolic murmur loudest at the heart apex. Her blood pressure was 215-110. She was tender to pressure across the upper abdomen but no mass could be felt at the site of the knotted feeling under the left costal margin. The vaginal discharge was apparently due to a vaginitis.

X-ray examination on May 2, 1927, showed a herniation of the upper half of the stomach through the esophageal opening of the diaphragm. The upper portion of the stomach lay within the thoracic cavity. The lower portion of the esophagus appeared to be displaced somewhat to the right. There was slight delay at the junction of the esophagus and stomach. There was no hour stasis and very slight delay in the upright position. The first portion of the duodenum was normal. The six-hour meal had reached the colon.

The diagnosis was hernia of the stomach through the esophageal opening, a finding which explained



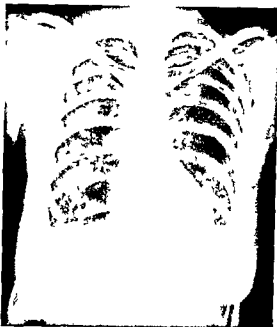


Fig. 1. Case 2. Gas bubble in stomach and hernial sac visible above the diaphragm. This significant finding is rarely observed in herniae through the oesophageal orifice.

3 a.m. On eating dry food rapidly she occasionally had distress under the lower sternum like forcing something through a small tube.

A report of the X-ray examination December 8 1928 follows. With the patient in the erect position no evidence of diaphragmatic hernia could be demonstrated. When the patient lay on her back no evidence could be seen at first but on turning her on her left side a portion of the cardiac end of the stomach entered the thoracic cavity. This appeared to be somewhat smaller than an orange in size.

The discovery of the hernia was entirely dependent on the X-ray examination with barium, without it this case would be classed as an excellent result from cholecystectomy. Closure of the hernia would have increased the operative risk, and the result 6 years after operation suggests that even if success fully carried out it was not a necessary procedure. Knowing the diagnosis, it is now possible to recognize symptoms arising from the hernia. During the past 6 years, the hernia has apparently increased very little in size.

CASE 2. A married woman of 52 years entered the medical service April 28 1927 complaining of

epigastric distress of a year and a half duration occurring after meals relieved by belching. Six years previous to entry she had been operated on for recurrent sharp pain which had been entirely relieved by removal of the gall bladder containing six stones. Her distress came on about half an hour after meals and consisted of a feeling of epigastric fullness accompanied by sharp pain between the scapulae. These symptoms were relieved by soda and belching and were apt to appear if she was fatigued or if she went too long without eating.

She was placed on liquid diet and had all her teeth extracted without benefit. On this regimen she lost weight from 158 to 110 pounds and eventually was confined to bed. On a more liberal diet her symptoms gradually disappeared until 2 days before admission when they recurred with severity. There had been no vomiting and no bloody or tarry stools had been observed. At times she had observed and felt peristaltic movements across the upper abdomen. There had been no chest pain and no difficulty in swallowing had been noted.

Examination showed an undernourished slightly pale woman with lordosis narrow costal arch, and scaphoid abdomen which was negative to palpation. The heart was slightly enlarged the chest otherwise essentially negative. Gastric analysis showed considerable stasis and increased hydrochloric acid but no blood. A strongly positive guaiac test was found in the stools. She had a moderate secondary anaemia. The urine was negative.

The report of an X-ray examination taken on April 9 1927 was as follows. Occupying the position of the cardiohepatic angle is a circular shadow apparently liquid in a cavity filled with gas. The barium is swallowed. The oesophagus seems to be deviated to the right in its lower third and also displaced considerably posteriorly. The stomach contains nearly all the barium meal at the end of 6 hours. When the patient lies on her back the barium flows into the circular area above the right diaphragm which appears to be a large pouch connected by a narrow isthmus with the body of the stomach. The stomach is large dilated and atonic. At times there are brief moments of fairly vigorous peristalsis. The duodenal cap is constantly deformed. A small amount of barium is in the small intestine none has reached the caecum.

The diagnosis was obstructing duodenal ulcer with diaphragmatic hernia of the stomach through the oesophageal opening. In view of the symptomatology the loss of weight and the definite obstructive duodenal ulcer operation was advised particularly since the patient seemed a reasonably good risk. Since the duodenal lesion had to be dealt with operation was necessarily by the abdominal route.

Operation was performed on May 6 1927 under ether anaesthesia. A median incision was made from the ensiform to below the umbilicus. The patient was hyperextended and the feet lowered. This gave a good exposure of the diaphragm. The

an old scar. The urine was normal. The blood showed a slight secondary anaemia.

X rays taken previously revealed a diaphragmatic hernia and a gall bladder containing numerous stones. A report of the barium examination of the stomach stated that the meal passed readily down the oesophagus to the cardia where there was a slight delay. The stomach filled in the usual manner and showed no irregularity of outline or peristalsis when patient was in the upright position. With patient in the supine position, a knob like projection was seen arising from the cardia close to the junction of the stomach and oesophagus. When the patient was rotated the shadow changed somewhat in shape but did not disappear until the prone position was reached. When the barium contents returned to the stomach the outline of the projection was visible however. This examination showed definite evidence of a variation from the normal near the cardiac orifice. The findings were thought to be due to a pouching of the stomach through the diaphragm. The deformity was reduced when the patient was upright. A large diverticulum of the lower end of the oesophagus was considered but the absence of filling in the upright position made this diagnosis very improbable.

In this patient, the principal complaints associated with eating were undoubtedly due to hernia of the stomach through the oesophageal orifice in the diaphragm. At the same time it was possible that the gall stones contributed to the distress and heartburn. Operation was offered on the following basis: the hernia would be explored if it seemed probable that the stomach might become tightly incarcerated or some other viscus strangulated; repair would be attempted provided the margins of the hernial ring were such as to promise a good closure. Failing these conditions the gall bladder would be removed if it could be safely accomplished.

An exploratory laparotomy through a right rectus incision was done on October 14, 1927. The peritoneal cavity was found free except for adhesions in the right lower quadrant and adhesions to the umbilicus. The liver was scarred large and low with a thin margin. The gall bladder was tense and full of stones. The stomach and duodenum were negative. At the oesophageal orifice there was a hernial pouch about 8 centimeters in diameter. This communicated with the peritoneal cavity through a large ring. There were no adhesions. In view of the size of the ring it seemed unlikely that a strangulation would occur. Exposure was extremely difficult and the sutures seemed unlikely to hold and consequently no attempt was made to repair the hernia. The gall bladder was removed.

On September 16, 1928 her son, a physician, wrote as follows: Since operation she has been practically relieved of her heartburn. She has had practically no trouble from the gaseous eructations and the distress which used to bother her. She has had two rather mild attacks like the ones she had before operation characterized by sudden inability



Fig 4 Case 4

to swallow during meals. These were precipitated by too rapid eating of dry foods. By avoiding dry foods and by very slow eating she can practically avoid recurrence of her trouble. Her general health appears excellent.

While the diaphragmatic hernia is unresolved in this case, the patient gets on quite comfortably by attention to details of eating. Removal of the gall bladder apparently led to definite benefit, possibly through improvement in gastric motility. In view of the operative findings, any sudden accident due to the hernia is extremely unlikely.

**CASE 5** A woman of 51 years entered the hospital January 31, 1928 complaining of increasing weakness of one year's duration which finally forced her to give up her usual housework. This weakness was accompanied by dyspnoea on exertion and by palpitation. She had no definite digestive symptoms; her appetite was fair and she had no nausea or vomiting. She suffered from habitual constipation and for many years had had at times a sensation of gas in the stomach, particularly after a full meal or on bending forward. She had no gross blood from the bowel and no flowing since the menopause 2 years previously. There was a questionable loss of weight. The remainder of her history was not important.

Study of her case by Dr A. V. Bock previous to admission showed a definite secondary anaemia.



Fig. 3. Case 3. Before operation. Barium filled part of stomach showing above diaphragm.

the left sided pain and cramp like sensations. Influenced by the ease of closure in the previous case, operation was advised although the symptoms were not urgent, and the patient was not a particularly good risk.

Operation was done under ether anesthesia on May 9 1927. The patient was slightly hyperextended with the thorax elevated. Exploration of the abdomen by means of a long incision through the right rectus muscle was negative except for the hernia and for adhesions in the gall bladder area. The upper part of the stomach had passed through the oesophageal hiatus into the hernial sac. The hernial ring easily admitted four fingers. The stomach was non adherent and easily delivered. Exposure for suture was difficult. Five interrupted sutures of chromic catgut were placed through the margins of the ring uniting it transversely. The tissues grasped by these sutures were not satisfactory in firmness.

Following operation patient's condition was fair. On the fifth day mild sepsis of the wound developed and at the same time elevation of respiration to 35 with a temperature close to normal. Dullness appeared at the left base which was interpreted on physical examination and by X ray as consolidation. There was cough with a moderate amount of expectoration. On the twenty sixth day a chest tap was done. 10 cubic centimeters of straw colored material being obtained with 70 cells per cubic millimeter. Cultures showed no growth.

She gradually improved and was discharged on the forty sixth day still with signs at the left base. X ray examination showed a recurrence of the hernia.

Following discharge she improved very slowly eventually regaining her weight and strength. During the fall a bulge developed in the wound which increased to a large hernia.

When seen on July 9 1928 she complained of the hernia in the wound which caused discomfort on cough or exertion. She had no indigestion or gastric distress and no difficulty in swallowing. Her complaints were directed to the incisional hernia alone. She no longer mentioned the symptoms existing previous to operation nor could any hint of a diaphragmatic hernia be obtained on close questioning. Nevertheless X ray examination showed a recurrence of the hernia.

Operation in this case was unwise. The symptoms did not justify the risks of exploration in a woman of her age and condition. It was particularly unfortunate that wound sepsis and pulmonary complications developed. The pleurisy with effusion was probably associated with lung pathology rather than with trauma to the diaphragm caused by suturing the hernia.

CASE 4. A married woman of 62 years was seen in consultation on October 10 1927 on account of painful attacks occurring during meals. These attacks had come on during the past year although previous to this she may have had some difficulty in swallowing. They were characterized by sudden distress as if she had swallowed too large a mouthful and occurred at irregular intervals always at table. The last attack occurred during dinner caused severe pain and was accompanied by vomiting and retching. Very little of the food eaten returned but only a frothy substance. Following this attack she was careful to chew thoroughly, and not to swallow too large a mass, and she had no further distress. Her general health was otherwise very good although she had suffered a good deal from epigastric distress and heartburn with regurgitation and was habitually constipated. Her weight was increasing.

She had had typhoid as a young woman two attacks of pleurisy with effusion and four abdominal operations. One 24 years previously for appendicitis and umbilical hernia, an hysterectomy 11 years previously and the others for subsequently developing cystic ovaries. The remainder of the history was unessential.

Examination showed a woman apparently in very good health. The chest was negative on auscultation and percussion. No murmur or splashing could be heard on swallowing. The abdomen was negative aside from a slight weakness in

diagnoses usually made. The danger, therefore, is that the actual cause of the symptoms, the hernia, may be entirely overlooked, even at operation. Consequently other operations are likely to be undertaken without the true diagnosis becoming established. Since the significance of slight variations from normal in its pathology and function have been so much stressed, the gall bladder would seem particularly likely to be removed.

Morrison (6) has followed some of his cases from 3 to 6 years and is firmly of the opinion that relatively few need operation. If these patients believe that the condition is not serious and understand how to take care of themselves they can tolerate their symptoms. This opinion is borne out by the clinical course of Cases 1 and 4. It seems probable that the symptoms are increased by factors tending to increase stasis in the stomach, such as organic obstruction of the pylorus, or spasm associated with ulcer or cholecystitis. Benefit may be obtained by relief of such conditions, although the hernia itself persists.

In regard to operative treatment the two attempts at suture were both failures, although this could not be demonstrated with out postoperative X ray examination. This check would seem to be extremely desirable before a case is reported cured. An unsuccessful attempt at repair might even increase the symptoms, either by constricting the hernial ring or by causing the stomach to become adherent within the hernial sac. Suture is rendered difficult by the width of the ring and by the presence of the œsophagus, which like the spermatic cord prevents complete closure. The condition would rarely seem to be serious enough to justify producing a unilateral paralysis of the diaphragm through section of the phrenic nerve to facilitate closure. These factors should all receive due consideration before operation is attempted directly upon the hernia.

The œsophageal hiatus is relatively accessible through the abdomen and less easy of

approach than other parts of the diaphragm through the thorax. The occasional existence of other intra abdominal pathological conditions would seem to make the abdominal route more desirable. Closure of the ring without dealing in any way with the ring margins or sac by means of interrupted chromic gut sutures did not hold in these cases. In future cases if closure of the hernia seems desirable, I should be inclined to attempt fascial repair.

The purpose of this paper is not to discuss operative technique, but to call attention to the possibility of overlooking hernia through the œsophageal orifice of the diaphragm and to certain characteristics of this condition. It would seem to be a condition causing little danger to the individual, so that operation is not imperative. On this account its treatment may well be considered independently from that of other types of diaphragmatic hernia in which the danger of intestinal obstruction is considerable. Since this form of hernia may cause a group of symptoms somewhat resembling those of other upper abdominal conditions it has definite importance in differential diagnosis and should be sought for in abdominal exploration. Discussion of diaphragmatic hernia would be clarified, with respect to diagnosis, prognosis, and treatment, if hernia through the œsophageal orifice were separated as a clinical entity, apart from the general group.

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(hemoglobin 50 to 55 per cent, red cell count 3 800 000) which accounted for her symptoms. Examination of the stools showed repeatedly a positive guaiac test but no gross blood. However, a ray examination of the gastro intestinal tract was negative, including that of the colon by means of a barium enema. The cardiac portion of the stomach projected upward above the level of the diaphragm. This herniation occurred approximately in the median line. The diagnosis was diaphragmatic hernia with no evidence of malignancy of the gastro intestinal tract.

Physical examination showed a woman somewhat overweight in apparently good condition aside from a moderate anemia. Otherwise the only important positive finding was rumbling sounds as of gas in a viscus heard over the chest posteriorly, particularly on inspiration. Rectal examination was negative except for a small fissure. Proctoscopy revealed a normal rectosigmoid mucosa, without evidence of bleeding from higher up.

The important feature of this case was the anemia which was incapacitating her and appeared to be due to hemorrhage into the intestinal tract above the rectosigmoid region. Since malignancy could not be completely excluded in spite of the negative X rays operation was advised and accepted.

On February 3, 1928 exploration of the abdomen was entirely negative aside from the diaphragmatic hernia. At the esophageal orifice there was an opening 6 centimeters across, oval transversely, through which the anterior part of the fundus of the stomach had prolapsed. The stomach was readily delivered. No attempt was made to close the ring which would have been difficult on account of its shape and the tension of the diaphragm. Since there was no obvious source of hemorrhage and no new growth within the peritoneal cavity the wound was closed after removal of the appendix. The sphincter ani was dilated.

Following operation she made a good convalescence. However, a positive guaiac test for blood appeared in the stool previous to discharge on February 20, 1928.

This patient was seen again in December, 1928. While superficially she appeared well and had maintained her weight she had been an invalid with the exception of 2 or 3 weeks in September on account of anemia with symptoms of dizziness, weakness, dyspnea and palpitation. The only evidence suggestive of hernia was in the stomach. The operative wound was well healed. Dr. Bock found a hemoglobin of 55 per cent, a red cell count of 3 000 000 and a strongly positive guaiac test present in the stools on two successive days. Proctoscopic examination by Dr. C. M. Jones was negative.

This patient suffered very little as a direct result of the presence of the hernia, and from this aspect repair was not essential. The

important point is whether her gastro intestinal hemorrhage and her consequent anemia were due to congestion of part of the stomach from constriction in the hernial sac. All that can be said is that no other cause of loss of blood has appeared during the 10 months since operation. On account of her disability, further operation is under consideration.

These patients were all women over 50 years of age, a fact suggesting an acquired condition and agreeing with Morrison's (5) statement that the condition is commoner in women. The symptoms are confused because of the associated pathology. Those that seem clearly due to the hernia were in Case 3, dull pain in the left upper quadrant with radiation to the back associated with a cramp like feeling, and in Case 4, attacks of difficulty in swallowing at meals with distress high in the epigastrium, occasionally with associated retching and vomiting. In Case 1, knowing the diagnosis, it is now possible to correlate mild symptoms with the hernia. These are regurgitation of a little gas and food after eating and a spasm of distress felt just above the ensiform, if dry or coarse foods are taken in a hurry. In Case 5, a persistent ooze of blood from the gastro intestinal tract is best explained on the basis of diaphragmatic hernia.

Healy states that the symptoms of this type of hernia present the widest variations. Large hernia may be present at times with out symptoms. Most of the patients complain of a vague discomfort or pain radiating to the back and often to the left shoulder. They may have regurgitation in the morning with hyperacidity if they have been sleeping on their backs. A few have difficulty in swallowing solid food at times. Morrison (5) mentions pain or distress just above or anterior to the ensiform cartilage, not epigastric, as the most constant symptom. There may be a lump under the sternum. The distress is frequently at night. Hematemesis may occur.

The history, therefore is not distinctive. It has features in common with peptic ulcer. The character and variability of the pain is somewhat suggestive of mild attacks of cholecystitis. Undoubtedly these are the

diagnoses usually made. The danger, therefore, is that the actual cause of the symptoms, the hernia, may be entirely overlooked, even at operation. Consequently other operations are likely to be undertaken without the true diagnosis becoming established. Since the significance of slight variations from normal in its pathology and function have been so much stressed the gall bladder would seem particularly likely to be removed.

Morrison (6) has followed some of his cases from 3 to 6 years and is firmly of the opinion that relatively few need operation. If these patients believe that the condition is not serious and understand how to take care of themselves they can tolerate their symptoms. This opinion is borne out by the clinical course of Cases 1 and 4. It seems probable that the symptoms are increased by factors tending to increase stasis in the stomach such as organic obstruction of the pylorus, or spasm associated with ulcer or cholecystitis. Benefit may be obtained by relief of such conditions although the hernia itself persists.

In regard to operative treatment the two attempts at suture were both failures although this could not be demonstrated without postoperative X-ray examination. This check would seem to be extremely desirable before a case is reported cured. An unsuccessful attempt at repair might even increase the symptoms, either by constricting the hernial ring or by causing the stomach to become adherent within the hernial sac. Suture is rendered difficult by the width of the ring and by the presence of the oesophagus, which, like the spermatic cord, prevents complete closure. The condition would rarely seem to be serious enough to justify producing a unilateral paralysis of the diaphragm through section of the phrenic nerve to facilitate closure. These factors should all receive due consideration before operation is attempted directly upon the hernia.

The oesophageal hiatus is relatively accessible through the abdomen and less easy of

approach than other parts of the diaphragm through the thorax. The occasional existence of other intra abdominal pathological conditions would seem to make the abdominal route more desirable. Closure of the ring without dealing in any way with the ring margins or sac by means of interrupted chromic gut sutures did not hold in these cases. In future cases if closure of the hernia seems desirable, I should be inclined to attempt fascial repair.

The purpose of this paper is not to discuss operative technique, but to call attention to the possibility of overlooking hernia through the oesophageal orifice of the diaphragm and to certain characteristics of this condition. It would seem to be a condition causing little danger to the individual, so that operation is not imperative. On this account its treatment may well be considered independently from that of other types of diaphragmatic hernia in which the danger of intestinal obstruction is considerable. Since this form of hernia may cause a group of symptoms somewhat resembling those of other upper abdominal conditions, it has definite importance in differential diagnosis and should be sought for in abdominal exploration. Discussion of diaphragmatic hernia would be clarified, with respect to diagnosis, prognosis, and treatment, if hernia through the oesophageal orifice were separated as a clinical entity, apart from the general group.

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## ENDOMETRIOSIS IN UTERINE CORNUA

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**G**LAND LIKE structures lined with columnar epithelium have been described frequently as occurring in the uterine and tubal wall in various locations, especially in the region of the interstitial or uterine portion of the fallopian tube associated with nodular enlargements of the cornua of the uterus.

Sampson has reported recently histological studies of the tubal stumps of a series of cases which had undergone salpingectomy or tubal sterilization at a previous operation and demonstrates multiform adenomata with varying resemblance to uterine or tubal mucosa. These are described as "histologically typical uterine or tubal mucosa apparently arising from the traumatized and activated mucosa of the tubal stump." Similar lesions adjacent but not immediately in contact he interprets as "seedlings" planted either as uterine mucosa washed from the tubal stump at the time of salpingectomy, or as a differentiation of traumatized tubal mucosa in the form of sprouts. These lesions, therefore, are grouped as "post salpingectomy" endometroses. These lesions first came to my notice in the Pathological Laboratory of the Lakeside Hospital several years ago as a somewhat frequently associated lesion in cases of salpingitis isthmica nodosa, in histological sections through the enlarged cornual portions of the excised tubes. Hence there can be little doubt that these adenomata, in our cases at least certainly existed prior to the salpingectomy and that they have not been transplanted or implanted subsequent to operation. If they are related to or derived from mature endometrium or tubal mucosa it appears that they may have occurred rather by direct invasion of tubal or uterine mucosa under some stimulus or from a common ancestral cell rest which assumes a tardy growth activity.

Therefore, the study was undertaken of a small series of cases of the nodular type of salpingitis, noted on pathological examination at the time of operation to have gland

like spaces situated principally in the uterine cornua. The morphology of these pseudo uterine glands as compared with that of the curettings obtained from the uterus at the time of operation, the presence or absence of physiological response to menstruation in the cornual gland spaces and the extent of the associated inflammatory disease of the tubes were noted.

Chiari, in 1887 described nodular enlargements of the fallopian tube as occurring in a small percentage of a large series of autopsy specimens. He explained these enlargements as the result of hypertrophy or hyperplasia of the wall of the tube and the small cyst like structures lined with columnar epithelium which are noticed scattered through the stroma, he accounted for as protrusions of the tubal mucosa cut off from the lumen of the tube under the influence of inflammation (Ries). The epithelial elements of gland like structures, hence are associated with both hypertrophic and hyperplastic changes in connective tissue. Epithelium lined cysts in the uterine cornua, found in connection with chronic inflammatory disease of the tube, have been regarded often as stigmata of gonorrhoea. Schauta originated the term most frequently applied to this lesion i.e., interstitial salpingitis or salpingitis isthmica nodosa.

Frank, quoting Rabinowitz Robinson, states that the tubal lesion is due on the other hand to tuberculosis in fully 25 per cent of cases of nodular enlargements which are near the cornual portion of the tube. This is so markedly in excess of the normal 5 to 6 per cent incidence of tuberculous salpingitis that it is striking. Consideration of these gland like structures occurring principally in association with inflammatory tubal disease, which have varying resemblance to uterine glands suggests that a study of these structures may cast additional light on the problem of endometriosis.

After careful study of the pathology of various types of inflammatory fallopian tubes

Curtis agrees with Ries that gland like epithelial spaces lined with columnar epithelium are initiated by inflammation. Such epithelial cysts are probably not always present with nodular inflammatory disease of the tubes as in our series where multiple routine sections showed gland spaces in 50 per cent of a small series of 'salpingitis isthmica nodosa' (not sectioned serially). Curtis has described gonococcal abscesses in typical nodular tubal enlargements of salpingitis isthmica nodosa, and (Schauta) invasion of such abscesses by epithelium has been proposed as the source of these epithelialized glandular spaces i.e., invasion of an abscess cavity communicating with the cells of the lumen or peritoneal surface which subsequently are nipped off by connective tissue elements producing these apparently isolated glands (Fig 2).

Many hypotheses have been advanced to explain the etiology of pelvic tumors of gland like tissue resembling endometrial glands. Von Recklinghausen explains these lesions as wolffian rests. The diffuse distribution of adenomatous nodules in the pelvis utero-sacral ligament and rectovaginal septum, etc. composed of gland like structures with varying round cell stroma and dense connective tissue as well as histological and biological correspondence of some of these lesions both as to glands and stroma with uterine mucosa has been emphasized by Cullen.

Wolffian origin and derivation from mesonephric rests have been variously suggested (Pfannenstiel, Pick, Babo). Others have suggested parent muellerian tissue as the source. Robert Meyer also has presented evidence in favor of the idea that under the stimulus of inflammation, cystic structures may come into being the growth extending from the surface of the epithelial lining of the tube into small abscesses in the tubal wall. Metaplasia and the ingrowth of the peritoneal mesothelium presumably as the result of inflammation has been noted (Ivanoff).

Sampson concludes from his studies that endometrial lesions occur frequently by direct implantation of fragments of mature endometrium or tubal mucosa either by transplantation directly, which apparently occurs

in abdominal scar endometrioma, or by regurgitation of the menstrual blood occurring through the fimbria of the tubes causing either primary implantation of the pelvis or secondary implantation after the process of "incubation" in the ovaries. The ovary, he believes, serves as intermediate host, and that hæmorrhagic cysts may often rupture discharging their content the cells of which are reimplanted to form additional metastases.

Most recently, Novak has pointed out the probability of ancestral coelomic mesothelial cell as the most probable etiological factor capable of undergoing evolution forming ectopic uterine endometrium. He believes the primitive coelomic mesothelium is concerned, in many instances at least, in the histogenesis of endometriomata and doubts the occurrence of menstrual flow through the fallopian tube with any frequency. This is in accord with our experience in a clinic where, though laparotomy is performed on menstruating women very frequently and where laparotomy is always preceded by a routine curettage, nevertheless we see blood exuding from the tubes with extreme rarity.

In accordance then with the theory of tubal dissemination of epithelial fragments it was recently suggested by Sampson that the endometrium like gland spaces found in the cornua of the uterus following previous salpingectomy were due to direct implantation of endometrial or tubal cells into the cut surface of the uterine wall at the cornu. This he assumes, occurs at the time of the removal of the tubes, and these cells then take root in the uterine cornua as implantation endometriomata. Certainly, these glands and stroma in appearance are often similar to typical uterine glands. Acceptance of this origin is, however not consistent with the common experience of finding such adenomatous spaces at the time of removal of the tubes particularly in the cases of nodular salpingitis or salpingitis isthmica nodosa. It is suggested by our observations on the following cases that the lesions found in the cornua at autopsy or operation long after salpingectomy, were in existence at the time of salpingectomy.





Fig 1 Case 1 No 14300 Section shows gland spaces of various sizes in round cell stroma suggesting endometrium. They are lined with medium high columnar epithelium and resemble very closely typical uterine glands.  $\times 67$

**CASE 1** C L colored aged 37 years 1 para No 14300 The patient entered the hospital complaining of pain in the lower abdomen profuse leucorrhoea and moderate dysuria. The anamnesis was of no importance except that some 6 weeks before a curettage had been performed for dysmenorrhoea at which time no inflammatory masses were palpated. On pelvic examination at this time the uterus, the outlet and cervix were in good condition, the uterus small and in midposition. There was bilateral thickening of the adnexa. At operation the uterus was in midposition and the sigmoid adherent in one place. Both tubes were enlarged especially at the proximal end. There were bilateral nodules at the cornua of the uterus the left being larger than the right. Supracervical hysterectomy was performed.

**Pathological diagnosis** The tubes were thickened covered with adhesions moderately adherent and the fimbriated ends closed off. The cornual portion of the tubes was enlarged and merged into the bilateral cornual tumors of the uterus.

**Histological examination** The cross section of the tube shows an intact high columnar epithelium lining the tubal lumen. There is complete absence of any infiltration about the lumen of the tube. The connective tissue elements are moderately hypertrophic and hyperplastic. Scattered at various intervals in this myofibroblastic stroma are gland like structures lined with cells with large even nuclei the glands resembling uterine glands perfectly. There is a well marked stroma surrounding this

group of glands (Fig 1). The cells of the stroma resemble quite closely the typical cells of uterine stroma. In general they are however slightly more elongated. There is no evidence of menstrual reaction although there are a few red cells in the lumen. There is no marked evidence of inflammation. Uterine curettings in this case showed very small glands uniformly distributed. The diagnosis was early resting endometrium. The nuclei of the lining of the cells of the tubal lumen occupy relatively less of the cell body than do the nuclei of these ectopic and endometrial gland cells. There is in the tubes a low grade of chronic inflammatory disease. However it is impossible to say whether salpingitis is an incidental accompaniment of these adenomata or that the growth of these glands was due to the stimulus of inflammation.

Figure 1 shows several gland spaces lined with medium height columnar epithelium containing a few red blood cells. There is a development of typical round cell stroma suggesting endometrium.

The section from another block (Fig 2) shows an organizing chronic abscess composed of a fibrinous reticulum in which there are entangled many plasma cells and polymorphonuclear leucocytes. In the wall can be seen a well marked epithelial border suggesting that epithelial cells may possibly be growing into an abscess cavity.

**CASE 2** M I colored aged 32 years 1 para No 14272 The patient was admitted to the hospital complaining of pain in the lower quadrants accentuated on the right side. She had fever and malaise of 2 weeks duration. Last history was negative. Five years previous the patient had symptoms of frequency and burning on urination. She had pain in the right side and was confined to bed for a few days recovering from her symptoms entirely at the end of a month. Three weeks later she was in bed for about a month with fever and abdominal pain.

Her menstrual history was negative. Laboratory findings revealed nothing except a mild leucocytosis. At pelvic examination there were small bilateral masses apparently adherent to the uterus. Laparotomy was performed. The tubes were found thickened adherent and enlarged close to the cornua of the uterus.

**Pathological diagnosis** The tubes were twisted and covered with adhesions the walls were thickened and the fimbriated ends were closed. Thickening of the wall was marked in the region of the uterine cornua where the stroma is extremely cellular.

**Diagnosis** Salpingitis isthmica nodosa. Cornual cysts. The uterine curettings showed a variance in type of glands ranging from small uniform glands of the zona compacta to glands of rather more complicated shapes in the deeper layers. There is some evidence of early premenstrual swelling the deeper layer glands showing papillary ingrowths. In other places there is a marked increase in the density of the stroma.

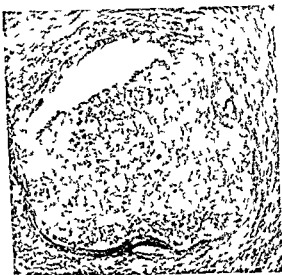


Fig. 2 Case 1 No 14300 The section from another block shows in one portion of the field an organizing chronic abscess composed of plasma cells, round cells and polymorphonuclear neutrophils. In the wall can be seen an epithelial border. This suggests rather that the epithelium invades and lines an abscess cavity rather than that this is an abscess in and about an adenoma. The single layer of epithelium contains very large nuclei which are undergoing active mitosis. X67

Figure 3 is a section through the cornual portion of the tube showing the lumen with typical placae. There are several large epithelium lined spaces with no endometrial stroma. There is moderate infiltration of the placae but the surface epithelium which is high columnar and ciliated is intact. The epithelium in the adjacent gland spaces is quite evidently a different type, the cells being smaller and the nuclei largely filling them. There is slight evidence of any inflammatory reaction in the epithelium lining the tube.

CASE 3 C R aged 29 years 1 para No 14404 The patient entered the hospital complaining of pain in the right side of 2 years duration. Pelvic examination revealed a normal vaginal outlet and a normal cervix. The uterus was small, retroverted and adherent and there were palpable bilateral masses. At operation the uterus was found to be held posterior by many adhesions. The tubes were enlarged and adherent to the pelvic floor and to the uterus. The tubes were sclerosed and covered with adhesions and the fimbriae were closed. The walls were definitely thickened. The macroscopic picture showed relatively slight evidence of any marked infection. The walls were slightly thickened and infiltrated with a few lymphocytes. There was slight desquamation of the mucosa of the tubal lumen. In the mucosa were gland spaces isolated from the tube lined by single low columnar epithelium. These were not surrounded by round cell



Fig. 3 Case 2 No 14272 Section shows cornual portion of the tube the epithelium of which is well preserved and unimpaired. Adjacent are several large epithelium lined spaces the appearance of which differs from that of the epithelium lining the tube. The integrity of the tubal lumen seems unimpaired as it is entirely symmetrical. These gland like spaces were in evidence at the time of salpingectomy. The lumen of the tube in the region of the cornua shows the almost complete absence of infiltration in the endosalpinx. Typical of the inflammatory process found in tubes of salpingitis isthmica nodosa is the relatively slight inflammation of endosalpinx and peripheral ends of the tubes. X80

infiltration. Uterine curettings showed glands of uniform size small with no variation or tufts. The glands were perfectly round. There were no areas of blood in the interglandular stroma.

Figure 4 is a cross section of the tubal lumen with adenomatous structures intervening and a section of the uterine endometrium. In the corner of the section was a small portion of what were apparently typical uterine glands with a relatively small amount of intervening stroma. These glands were undergoing a reaction of hyperplasia with subepithelial infiltration of blood. (The curettings were in the resting state.) There was no evidence of a similar reaction in the adenomatous spaces. The cells lining the tubal lumen however showed some desquamation. The cells lining the lumen of the adenomata however were perfectly intact. The morphological differences between the epithelial cells of the adenoma and of the uterine glands were particularly marked in this section the cells of the uterine glands



Fig 4. Case 3. No 14404. The section shows a cross section of the same tubal lumen with adenomatous stroma intervening in the section of uterine endometrium. There is some evidence of premenstrual hyperplasia in the uterine glands. Cells of the uterine glands are markedly different from the cell of the interstitial adenomata. The epithelium of the adenomata resembles more closely the cells lining the lumen of the tube.  $\times 55$



Fig 5. Case 4. No 12496. Here are several glands of the uterine type. It is a round and spindle cell stroma, the cells of which may be seen to blend into the typical connective tissue cells of the interglandular stroma. The adenomata, however have a typical endometrial appearance but there is no reaction comparable to the endometrium which in this case was in late premenstrual phase.  $\times 67$

being markedly high columnar with nuclei situated in the bases and with desquamation going on whereas many of the adenomata were composed of low columnar epithelium with not the slightest suggestion of response to menstrual reaction and differing entirely in appearance from the adjacent uterine glands as well as from the larger tubal cells the intracellular area of which was almost entirely occupied by their nuclei.

CASE 4. No 12496 colored aged 22, 1 para. This patient came to the hospital complaining of pain in the right lower abdomen. The urine was negative. White blood cell count was 11,200. The outlet was marital the cervix was in good condition and the uterus was anterior and slightly fixed. A low mid line incision was made. On inspection of the pelvis, there was found bilateral thickening of the isthmus portion of the tubes. The pathological diagnosis was typical salpingitis isthmica nodosa. Microscopically the tubal mucosa was in good condition there being practically no desquamation. There was apparently slight round cell infiltration of the plicae. The tubal epithelium was medium high columnar.

Scattered through the stroma were numerous gland like spaces composed of a very low cuboidal epithelium not suggestive of tubal wall. There is no suggestion of reaction to menstruation. Uterine curettings showed a great increase in the glandular elements the glands being tortuous with papillary swellings in the mucosa lining. There was the

typical cork screw appearance of premenstrual swelling. There was complete absence of inflammatory reaction in the tissue.

Figure 5 shows several glands of uterine type. There is a round and spindle cell stroma, the cells of which are apparently modified connective tissue cells and merge into the typical elongated connective tissue cells by definitely perceptible degrees. The glands however are definitely endometrial in appearance.

Figure 6 shows gland spaces of the larger size with very low cuboidal epithelium differing entirely from the typical furry lining of the tube. The epithelium is not flattened by the distention for there is no bleeding and no attempt at a menstrual response.

There is a rather marked inflammatory infiltration of the stroma of the tubal wall (Fig 7). The lumen of the tube has disappeared and is replaced by an infiltration of round cells and polymorphonuclear cells forming chronic abscesses so that it is impossible to discover exactly where the lumen of the tube was originally. This section suggests that such inflammatory processes may be the means by which epithelium is nipped off from the tubal lumen or possibly, from the other point of view, mesothelial cells of the peritoneum may penetrate from the surface.

CASE 5. A. A. G. aged 33 years 2 para. No 12956. The patient came to the hospital complain



Fig 6 Case 4 No 12496 Section shows a gland space lined with very low cuboidal epithelium in appearance differing entirely from the lining cells of the tube. The epithelium was not flattened by distention for there was no attempt at the menstrual response.  $\times 55$



Fig 7 Case 4 No 12496 The section shows a marked inflammatory infiltration of the stroma the lumen of the tube having disappeared and is replaced by a chronic abscess composed of round cells and polymorphonuclear leucocytes.  $\times 55$

ing of dysmenorrhœa and frequency on urination. The outlet was marital the cervix was eroded small and lacerated and the uterus was enlarged and anteflexed. There was thickening and a tender mass, the outlines of which were made out with difficulty on the right side. At operation there were found numerous adhesions. There had been a previous salpingectomy and there was a nodule at the uterine cornu on the right side. This was excised. Histologically the sections showed a rather dense fibrous connective tissue large cystic spaces without evidence of stroma lined by a very low cuboidal epithelium. There is little evidence of inflammatory reaction here. Uterine curettings show typical resting endometrium. This is a case which might be assumed reasoning *post hoc propter hoc* to be an example of postsalpingectomy endometriosis for a salpingectomy preceded the recovery of the cornual nodule by several years. However in the light of the four preceding cases I am inclined to assume that the lesion antedated the salpingectomy.

Twelve cases of salpingitis isthmica nodosa were studied and cornual adenomata were found in five which gives one the impression that there may be a relationship between inflammatory disease of the tube and cornual "endometriomata". This is in marked contrast to the fact pointed out by Sampson that endometrium like lesions outside of the uterus are almost invariably associated with patent

tubes, i.e., absence of severe tubal disease. It is well known that an inflammatory process can produce a hyperplasia of epithelium and a marked increase in its rate of growth. In favor of the tubal or peritoneal theory of origin of these lesions is the fact that these lesions seem to show a response to the menstrual stimulus at least to the extent of actual gross bleeding. Novak has recently shown clearly that cyclic changes characteristic of menstruation occur in tubal epithelium but without any bleeding.

The amount of characteristic stroma surrounding the glands is also capable of a great variation. The photomicrographs show every grade of transition clearly from the typical stromal cell of uterine type to the elongated cells of fibrous connective tissue, which suggests that the ordinary connective tissue cell become modified *in situ* to form the stromal cell which surrounds these glands. Frequently, in cornual adenomata as well as other endometrium like adenomatous lesions there is absence of stroma suggesting true endometrium.

Examination of sections through the cornua of uteri removed for prolapse, chronic subinvolution, etc., or of sections through the uterine end of tubes removed with a cornual wedge for ordinary types of salpingitis, reveals no such adenomatous structures as occur with the inflammatory lesion known as salpingitis isthmica nodosa.

#### SUMMARY

We find in certain cases, at least, of salpingitis isthmica nodosa, the occurrence of cornual adenomata with a greater or lesser resemblance to uterine or tubal epithelium and with a varying amount of surrounding stroma which suggests, in appearance, that of the uterus.

These lesions apparently do not react always with characteristic changes to the menstrual cycle which suggests the condition of hyperplasia of the endometrium (Fig. 1). The severity of the infection is probably not an important factor, for the fimbriated ends of the tubes are frequently patent although the cornua may contain many adenomatous lesions and the lumen of the tubes may be completely replaced by hypertrophic and hyperplastic connective tissue and leucocytes.

It is possible that these lesions may occur as sprouts from traumatized tubal or uterine mucosa after salpingectomy, but they existed in these cases (1, 2, 3, and 4) certainly at the time of salpingectomy.

#### CONCLUSIONS

1. Adenomatous lesions of the uterine cornu occur frequently in association with the form of inflammatory disease of the tube known as salpingitis isthmica nodosa and may be demonstrated at the time of salpingectomy. It seems unlikely that they arise commonly after salpingectomy from implantation or outgrowth of traumatized tubal or uterine mucosa.

2. While infection may be an etiological

factor in the production of cornual adenomata, the severity of the associated inflammatory process is variable.

3. Adenomatous structures, except for parovarian tubules, are seen infrequently in normal uterine cornua.

4. The morphology of cornual adenomata varies widely, and response to the menstrual stimulus in the form of bleeding is uncommon.

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## THE MORPHOLOGY OF NORMAL MENSTRUAL BLOOD AND ITS DIAGNOSTIC VALUE

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VON DER LEYEN, Lindner, Sekiba, and others have studied the tissue extruded during the menstrual periods and all have found that in the early days of the menses mucosa is passed with the menstrual discharge. Rotter investigated the morphology of the menstrual blood, paying particular attention to the hematology. He believed that he was able to demonstrate the diagnostic value of differential white cell counts and concluded that the findings in the genital blood might be of assistance in diagnosing carcinoma and in recognizing the interval bleeding due to inflammatory disease.

This investigation was undertaken to determine whether the morphological findings could be utilized to differentiate normal menstrual blood from other bloody vaginal discharges. One hundred specimens have been examined, some few in a complete series from the first to the last day of menstruation, others on 1, 2, or 3 successive days and of others only one or two samples have been taken.

To obtain the material a glass tube was placed in the vagina, just within the introitus, and was fastened in place with adhesive tape. The women were kept in bed during the entire period, if necessary. The blood collected was divided into two parts—the one fixed while fresh in acetic acid, 36 per cent, the other in 50 per cent alcohol. In some instances 10 to 20 cubic centimeters were obtained in a few hours, in others only 1 cubic centimeter, which we found in most instances ample for our purpose. The material was centrifuged when necessary, fixed embedded in paraffin, cut, and stained. Hematoxylin eosin, Van Gieson and occasionally other special stains were used.

The constituents that were particularly studied were the vaginal and uterine epithelium and leucocytes both mononuclear and polynuclear. The uterine epithelium was found in most marked profusion on the second day of the period, on which day it occurred

in 74 per cent of the cases. On the first day it occurred in only 50 per cent, on the third day, in 54 per cent. On subsequent days with a few exceptions, it was not found. It occurred as small strips of columnar epithelium at times consisting of only a few cells, well stained and as far as the histological appearance could determine, viable (Figs 1 and 2). At other times the epithelium occurred in long strands with many cells, some well stained, others showing degenerative changes. It occurred also as small clumps of glands, while in some instances, only one tiny gland (Fig 5) was found. In other specimens the epithelial tissue appeared as large fragments, with tortuous glands and surrounding stroma, while in several instances large masses, similar to the tissue expelled in membranous dysmenorrhea were found (Fig 3). In this latter type no history of unusual pain was elicited. It would seem that with the first appearance of the menstrual flow, uterine desquamation has already taken place, that it becomes more marked on the second day, diminishes on the third day, and ceases on the fourth. This seems to be the sequence in the usual 4 to 5 day type.

We also found clumps of stroma cells which occurred entirely independent of the epithelium and in varying profusion. They may occur as small groups of darkly stained cells, oval, round, or polygonal, varying from 5 to 20 cells (Fig 4). The nuclei appeared normal, well stained, though at times they showed pyknosis or other evidence of degenerative change. However, the stroma did not show the same extent of necrosis as the epithelium, though in both cases the viable tissue (that is, viable as judged by the histological appearance) far exceeds the degenerative tissue in amount. The stroma extrusion too shows variations, being more common on the second and third days on which days 90 to 91 per cent of the specimens contained stroma free from epithelium in varying amounts.



Fig. 1 No 3540 Stop of surface mucosa with small amount of underlying stroma and one small clump of stroma cells sufficient for diagnosis of menstrual blood  $\times 150$

On the first day 75 per cent of the specimens contained stroma while on the fourth day 50 per cent of the cases were still discharging stromal fragments. The presence of these fragments is extremely characteristic and constant and though in some instances only one or two tiny clumps may be found yet they are sufficiently characteristic to warrant the



Fig. 3 No 35211 Large plaque of mucosa showing some well preserved epithelium both on surface and in the glands. Decidual reaction in the stroma. Resembles tissue expelled in membranous dysmenorrhea  $\times 120$



Fig. 2 No 34635 Large fragment of mucosa showing surface epithelium and a few glands marked pyknosis of nuclei. Sufficient for diagnosis of menstrual blood  $\times 125$

diagnosis of menstrual blood. A large group of control cases will be reported at a later time. It need only be stated here that in 100 control cases the above features characteristic of menstrual blood were not present.

We see a slight difference between the desquamation of the stroma and that of the epithelium. The stroma appears as does the epithelium on the first day, increases progressively up to the third day, maintains a maximum desquamation for 2 days then diminishes on the fourth and fifth days. It is evident that the amount of desquamation varies in each individual case and may also vary at each period. This variability may account for the divergent views offered by many authors as to the nature and extent of the mucosal destruction.

It is true that in a certain proportion of the cases (9 per cent) either uterine epithelium or stroma or both were missing. This, of course, might be due to the fact that not enough material was examined or that in certain individuals desquamation does not take place.

Corner<sup>1</sup> has described in monkeys a periodic fundal bleeding not associated with ovulation and not accompanied by the usual mucosal hypertrophy. It is possible that the absence of the mucosa in this small group of human

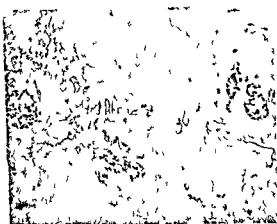


Fig 4 No 34835 Small stroma clumps of well preserved cells sufficient however to make diagnosis of menstrual blood Vaginal spindle cells shown  $\times 15$



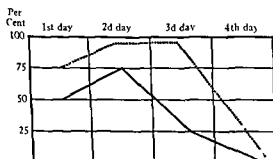
Fig 5 No 33517 Masses of isolated spindle cells of varying types: boat shaped large and compressed spindle cell One small uterine gland is shown  $\times 15$

cases may be explained on a similar basis namely, that in certain individuals menstruation takes place without mucosal desquamation if not at every period possibly at some of the otherwise normal cyclical hemorrhages (Graph A)

Another striking finding was the presence of desquamated vaginal epithelium. It was difficult to establish a definite rhythm as it appeared in practically every specimen of menstrual blood. We designated the epithelium as vaginal spindles if it appeared as isolated cells and as vaginal plaques when it occurred in sheets. In the first group the cells occurred singly as either short flat spindles containing a small round central nuclei, pale staining with a few taking a more intense stain, or as elongated spindles with very faint

staining round or elongated nucleus or with no nucleus. These latter appeared as cell shadows (Fig 5). This fat spindle had been described by Papanicolaou<sup>1</sup> in the vaginal specimens from pregnant women. Often about them were clumps of bacteria. The vaginal spindles occurred in 05 per cent of the cases on the first and second day, in 82 per cent of the cases on the third day, and in 100 per cent of the cases on the fourth day. The individual number of cells varied—in some the spindles were numerous occasionally

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Graph A Variation in occurrence of uterine mucosa in the menstrual blood. Dotted line represents stroma solid line epithelial element



Fig 6 No 215 Large fragment of vaginal mucosa showing vacuolization small well preserved cells. Such large fragments as these are not common  $\times 120$



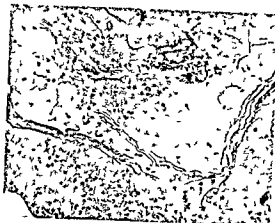


Fig No 35211 Strips of cornified vaginal mucosa one showing at its extremity a flat plaque of epithelium cut tangentially  $\times 130$



Fig 8 No 33333 Large plaque of cornified epithelium The origin of the vaginal spindles is from the plaques  $\times 120$

the slide being covered with them, 50 to 100 in a field, in others they were more scanty, sometimes only one or two to a field

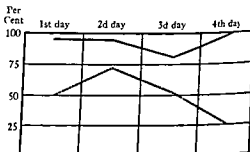
The vaginal plaques likewise vary in their appearance Three types were observed In one the plaques are composed of layers of squamous epithelium varying in number from 3 to 4 cells to masses of 100 or more (Fig. 6) and from 3 to 4 layers to 10 or 20 Here, too as in the spindles the cells are pale staining and apparently non viable The second type is represented by plaques of large spherical or polygonal cells probably the variation in the direction of the section making the difference in appearance The nuclei in

both groups are small round badly stained and centrally situated (Fig 7) The third variety is seen as strands of cells, one or more layers in thickness crowded non nucleated dark, in many the cell markings are gone These are just strands of cornified non viable superficial epithelium (Fig 8)

The plaques are not as numerous as the cells but are present in sufficient profusion to be easily found On the first day they occur in 50 per cent of the cases rising on the second day to 72 per cent dropping again to 55 per cent on the third day and to 25 per cent on the fourth day Whether this vaginal cycle is dependent on a true endocrine impulse or results from maceration by the menstrual blood, cannot as yet be determined (Graph B)



Fig 9 No 33230 Vaginal plaque infiltrated by polymorphonuclear leucocytes showing the penetration of the mucous membrane by leucocytes and the mechanism by which the leucocyte count in the vaginal blood is increased  $\times 120$



Graph B Variations in occurrence of vaginal mucosa in menstrual blood Dotted line represents vaginal plaques solid line vaginal spindles

TABLE I—SHOWING PERCENTAGE VARIATIONS OF THE OCCURRENCE OF UTERINE AND VAGINAL ELEMENTS ON SUCCESSIVE MENSTRUAL DAYS

	1st day	2d day	3d day	4th day
Uterine epithelium	50	74	25	3
Uterine stroma	75	90	91	4
Vaginal spindles	95	95	82	100
Vaginal plaques	50	72	55	25

Recently Dierks<sup>1</sup> described a cyclical desquamation of the vaginal mucosa corresponding to the cycle of the uterine mucosa. Our findings seem to substantiate his work, but at present we do not feel warranted in accepting all of his findings.

In collaboration with Dr Allan Guttacher I have studied 34 vaginal spreads from women whose menstrual history was known, and the findings suggested that during the menstrual period the sheet desquamation was most common. This work will be elaborated and reported on later (Table I).

A study of the white blood cells shows a striking finding. The number of polynuclear leucocytes varies tremendously. In the majority of the cases, they are fairly numerous, much more than could be accounted for by the presence of the menstrual blood *per se*. In a preliminary study of 20 cases where the leucocyte content of the circulating blood and of the menstrual blood as it escaped from the cervix was determined it was found that while the cases had a normal count in the peripheral blood the white cell count in the menstrual blood ranged from 1,200 to 5,200. In other words one of two things must have happened either the white blood cells when they escape in the menstrual blood degenerate very rapidly or the white blood cells do not leave the uterine blood space in the same

proportion in which they are present in the circulatory blood. Whether they leave the capillaries and remain in the tissues to perform some reparative function or whether they wander back into the blood stream, cannot at present be answered. It is also possible that because of their greater density they lag behind, adhering closely to the posterior wall and so do not appear in the streaming blood, or that they agglutinate to form some small blood clots, the predominating constituent of these clots being the white blood cells.

To account, therefore, for the increase in the number of white blood cells found in the menstrual blood, contained in the vagina, over the number of white blood cells found in the menstrual blood as it issues from the cervix, some origin other than the blood itself must be considered. It would seem most reasonable to attribute this condition to an exudation through the vaginal mucosa (Fig. 9).

In some instances the number of polynuclear leucocytes was so great as to suggest pus, histologically. In practically all of these cases inflammatory factors were present either as pelvic exudates or diseased adnexa. On the other hand, in a number of cases, when inflammatory pelvic disease was diagnosed by other criteria, the white cell content of the vaginal menstrual blood did not contain an excess of leucocytes. Apparently the presence of pelvic infection did not always cause an increase in the leucocytic content of the vaginal blood. How to account for this variation cannot be determined at present.

#### SUMMARY

In menstrual blood we find a definite number of elements which are so characteristic and stable as to enable us to differentiate with certainty menstrual blood from blood of other types of genital bleeding. This fact is of value in that it gives us an additional diagnostic aid in pelvic diseases accompanied by hæmorrhage.

<sup>1</sup>Arch. f. Gyn. ek. 1917, 22: 246.

## THYROID TISSUE TUMORS OF THE OVARY

WITH THE REPORT OF AN APPARENTLY TOXIC CASE

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**A**LTHOUGH about 50 cases of struma ovarii are reported in the literature,<sup>1</sup> the determination of the actual frequency of this tumor type is rather difficult. In view of the fact that Pick found thyroid tissue in 6 out of 21 dermoids, and Rohdenburg saw thyroid tissue 9 times in a series of 500 ovarian tumors, it seems unlikely that struma ovarii is really so rare as the relatively few cases reported would indicate. However, there is no standard to determine whether a tumor containing thyroid tissue should or should not be designated struma ovarii; some men consider any growth containing thyroid tissue as struma ovarii, whereas other authors designate only such tumors as are made up wholly or for the most part of thyroid tissue as belonging to the group of ovarian goiters. Certainly, a differentiation is difficult here. The amount of thyroid tissue present may not always be the important factor (see Case 3 reported here), any more than the toxicity of a neck goiter can be judged by its size.

Aside from these difficulties in determining the frequency of occurrence of such tumors there is also some question as to how many of the cases reported as struma ovarii really are what they were represented to be, since Bauer in 1924 reported his case of "pseudo struma." This was a cystadenoma of the ovary derived from invaginations of the germinal epithelium of the ovary which resembled thyroid tissue so closely that even Langhans of Bern, to whom the sections were submitted, was convinced that he was dealing with thyroid tissue. Bauer concluded from his case which he interpreted as a "pseudo mucinous cyst," that all the so-called thyroid tissue tumors of the ovary are but atypical pseudomucinous cystadenomata and not

teratomata at all. Aside from the fact that the morphology and epithelium of the cyst adenoma described by Bauer did not seem to fit a pseudomucinous cyst, and that the fluid contents of the tumor were not chemically examined, there are a number of other objections to Bauer's hypothesis, which, however, I do not have to go into here as I have offered them before<sup>2</sup> following a detailed study of the first two cases presented here. These cases had been seen at the Universitäts Frauenklinik of Tübingen just prior to the appearance of Bauer's article.

**CASE 1.** M. J. Hosp. No. 243, 1914. Peasant woman, aged 44 years, married, mother died of uterine tumor. One brother died of pulmonary tuberculosis. Patient had 8 normal labors and 1 abortion. Last labor occurred July, 1910. Periods always were normal. Last menstruation occurred 1 week before admission to the hospital. The woman sought medical aid because she had suffered for the last few months from very severe pains in the back and burning on urination.

General physical examination revealed nothing of importance except a small goiter which, however, is very common in that particular community.

**Gynecological findings.** On the patient's right side a resilient cystic intra-abdominal tumor could be felt. It evidently had its origin in the pelvis and extended well up above the umbilicus. The external genitals, urethra and bladder were normal, but the posterior vault of the vagina was pushed downward by the aforementioned cyst. The tumor was about the size of a large cantaloupe. The cervix uteri was high up behind the symphysis pubis, the uterus normal in size, hard anteflexed but misplaced to the left. A definite pedicle leading from the tumor to the side of the uterus could not be felt.

**Diagnosis.** Cystic tumor of the ovary.

Laparotomy was performed on the patient and showed that the growth, the pedicle of which was twisted twice upon its axis, originated in the left ovary. The cyst together with the left tube was removed. The contents of the cystic tumor which was punctured to facilitate removal were thus watery, clear and light yellow in color. The right tube was normal. The right ovary contained several small cysts which were punctured.

The patient made an uneventful recovery and was well when last heard from 3 years later.

<sup>1</sup>See literature e. g. Dingel, Ueb. d. Anat. u. d. Klin. Verh. d. Struma thy. de ovarii. In: u. gynecol. dissertation Bonn 1914. Ad. Ibb. Arch. f. Gynaek. 1918. 1918. 1919. who collected 40 cases from the literature. 21 reported two more, and Frankel and Ledtke. — Am. J. Obst. & Gynec. 1913. Sept. who found 6 more cases and added the 1 of the 1911. 1912. 1913. however the case of Bolt (Canad. M. Ass. J. Monr. at 19. 1911. whose case (61 years old) is by the way the oldest reported in the literature with struma ovarii.

**Macroscopic description of the tumor** The left ovary i.e. the cystic growth was about the size of a large cantaloupe. Its outer surface was smooth except for an encircling depression which divided the growth into two (about equal) halves. The somewhat thickened tube was closely adherent to the upper surface of the growth. The fimbriated tubal end was patent. The walls of the cyst consisted of tough fibrous tissue about one millimeter in thickness. The interior of the tumor was divided into two cavities almost equal in size (*a b* Fig 1). The location of this dividing septum corresponded to the aforementioned groove on the outside of the cyst. Immediately below the tube in the wall of the cyst *a* and the septum between *a* and *b* there was a hard mass about the size of a hen's egg (*d* Fig 1). On section this proved to be a dermoid cyst filled with hair and sebaceous material. The nucleus of the dermoid cyst (*s* Fig 1) was approximately the size of a pigeon's egg and quite firm with several very hard nodules. The wall of cyst *b* was only loosely connected with this small hard growth.

On transverse section the latter presented the typical picture of a struma colloidescens cystica the cysts ranging up to the size of a large pea. Some of the cysts were filled with a light yellow colored colloid whereas others in the softer parts of the growth contained a more milky looking jelly. The contents of some of the transversely cut cysts could be lifted out with a needle in the form of small translucent hemispheres. The cysts were larger in the upper portion of the growth which also was darker in color than the lower half. The smaller cysts in the lower half were on the other hand packed very closely together so that this part of the struma looked very much like a mass of solidified glue in which the thin connective tissue walls of the individual cysts could be discerned only as fine irregular lines.

Macroscopically no ovarian tissue was seen anywhere.

**Chemical examination** The colloid in the cysts was examined by the Baumann Ostwald method for traces of iodine. We employed the technique recommended and used by Weinberg in testing for chlorine and iodine in the ovary but were not able to find any iodine. A further chemical examination of the colloid for pseudomucin<sup>1</sup> likewise gave negative results. The negative reaction for pseudomucin cannot be explained by the formalin fixation of the specimen since it has been shown that pseudomucin will dissolve in weak alkaline solutions even after weeks of hardening in formalin. The contents of the two larger cysts could not be examined chemically as they were lost at the time of operation.

**Microscopical description of the tumor** Numerous pieces were cut from different parts of the cyst walls and out of the small struma like nodule. The separate pieces were embedded in paraffin and stained with hematoxylin-eosin and according to Van Gieson. I tried to cut the struma serially but this

Hammensen's method Ha di d Gyna k 1905 IV 2

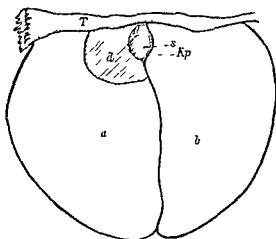


Fig 1 Diagram of tumor of Ca 1: *a* Cyst *b* cyst *s* struma nodule (dermoid nucleus) *T* tube *Kp* capsule formed by wall of cyst *b* and only loosely attached to *s*

proved impossible on account of the extreme hardness of the material and I had to be content with the best sections obtainable at different levels of the specimen.

The first sections examined were those cut from the struma. Outside of a piece of skin with sebaceous glands found in three slides of this series, the predominating histological picture was that of a typical cystic goiter. Cysts of varying size alternated with clumps and bands of epithelial cells. Usually the cysts were separated from one another only by fine connective tissue trabeculae (see the struma tissue in Figures 3 and 4) although in some parts of the tumor this connective tissue formed more massive bundles (Fig 2). A thickening of the connective tissue had also taken place between some of the larger apposed cysts. The fibrous tissue in the last named location was as a rule highly cellular and frequently contained small blood vessels. Each area as a whole was subdivided into lobules by large more or less hyaline degenerated connective tissue bundles with at times a few smooth muscle fibers. Some of the slides examined showed an invasion of the connective tissue by the struma although all other evidence of malignancy was lacking.

The smaller struma cysts were lined with low cuboidal epithelium which became flatter in the larger cavities. The protoplasm of the cells was light in color the nuclei dark round or oval. All the cysts contained an almost homogeneous substance which the eosin had stained a brilliant red. In some places this colloid showed vacuoles or darker colored round or oval spots. These latter were probably nothing more than small areas of condensed colloid best explained by some inner chemical change. Under the higher powers of the microscope the colloid had a finely granular structure and frequently contained desquamated epithelial



Fig 2 The struma tissue is interspersed with abundant fibrous connective tissue. The darker areas in the colloid of the larger cysts are probably due to chemical changes. Above in the picture thick bands of fibrous connective tissue are visible. Below on the right there is a blood vessel. Leitz ocular  $\times 40$  objective  $\times 3$ .

cells especially in the larger cysts. The latter cysts also frequently showed little papillomata covered with epithelium projecting into the lumen of the cavity. Some of these little excrescences were solid others contained small cysts of their own. They had exactly the same character as the little papillomata found in goiters of the neck. Such papillomata however, had to be distinguished from torn remnants of intercystic fibrous partitions. Where small cysts had been cut on a tangent at times solid cell clusters appeared but not infrequently the colloid underneath shone through in a faint red color, or would come to the surface in places where the cyst wall had been cut away.

Near the center of the growth the histological picture changed entirely. Instead of struma tissue a typical adenocarcinoma which was divided into larger and smaller alveoli by fairly thick bands of hyaline degenerated connective tissue was seen. Nearly everywhere there was a sharp line of demarcation between the carcinoma and the struma. Only one spot (Fig 4) showed a transition between the two types of growth. The goiter here first changed its character to that of a malignant struma and this then acquired more and more a typically carcinomatous aspect until only cancer was present in the microscopic field.

No ovarian tissue was found in the tumor. The capsule of the struma was formed by the wall of cyst  $\delta$ . The wall of this cyst was composed partly of connective tissue. The outer layers showed more or less parallel fibers whereas the inner connective

tissue bundles were more irregularly arranged. The connective tissue found in the goiter was derived from the inner strata. It was fairly well supplied with blood vessels some of which showed a thickening of the walls. Lymph spaces were moderately frequent. In some places deposits of blood pigment were noticed. The cyst wall forming the capsule around the goiter showed no epithelium. There were nowhere any invaginations from the surface and no ovarian tissue whatsoever was discovered. The other sections from the cyst wall showed practically the same structure as described above. Epithelium was seen in but a few places and even there it was not well preserved. The cells were flattened and contained a light protoplasm and small oval nuclei.

The fallopian tube showed a moderate chronic inflammatory reaction but nothing else of importance.

CASE 2 F R Hosp No 279 1914 Peasant woman aged 46 years virgo intacta. The patient had been operated upon when a child for pus in the right arm. She had had facial erysipelas twice jaundice once. Her menstruation had always been normal the last period occurring 2 weeks before admission to the hospital.

The patient came to us because her abdomen had been increasing in size for years although marked swelling accompanied by occasional shooting pains and oedema of the left leg had been present only during the last 3 or 4 weeks.

**Physical examination.** Here as in Case 1, was found a struma colli about the size of a hen's egg. The left leg was normal at the time of the examination but the right leg now showed oedema. The heart was slightly enlarged. On the right arm was an old scar (see case history).

**Gynecological findings.** The woman had a circumference at the waistline of 106 centimeters. The whole abdomen up to the costal margin was filled by a resilient smooth cyst. The anterior vaginal fornix was pushed downward by the growth. The uterus was a trifle small hard retroverted and pushed toward the left. The pedicle of the tumor was attached to the right cornu of the uterus. The left ovary could not be made out.

**Diagnosis.** right sided large ovarian cyst with pressure symptoms. Uterus rather small.

Laparotomy was performed and the cyst punctured and removed together with the right tube and the cystic left ovary and left tube. The woman made an uneventful recovery and was well when last heard from 5 years later.

**Macroscopic description of the tumor.** The extirpated cyst originally must have been about the size of a full term pregnant uterus. There was one very large cyst (a Fig 5) about twice the size of an adult's head and a number of smaller cysts  $\delta$ . The outside of the tumor was smooth except for the bulging caused by some of the smaller cysts. The tube was thickened and elongated and ran along the upper and anterior surface of the growth. The con-



Fig 3 Above colloid cysts of larger size than in Figure 2 are present also small papillary projections into the lumen of the cysts and at A remnants of a torn intercytic wall. Below there is a typical alveolar carcinoma separated definitely at all points in the picture from the struma. Leitz ocular No 2 objective No 3



Fig 4 Transitions are seen here between the struma on the right side and the carcinoma. Near the center numerous small colloid cysts are still present in the carcinomatous tissue. Leitz ocular No 2 objective No 3

tents of the main cyst were clear and watery (as found on puncture at the time of operation) whereas the contents of many of the smaller cysts were turbid looking very much like pea soup. The walls of the individual cysts were rather thin. Their structure was similar to that described in Case 1. There were dense fibrous adhesions between the tube and the cyst wall. The latter was also greatly thickened in this location. At one point a calcification (k Fig 5) was present. The calcified area was about the size of a penny and of a yellowish color. At this same place the capsule of the tumor (teratoma) was much thickened.

Below the fallopian tube and near its uterine end another cyst about the size of an orange was present (c Fig 5). The inside of this cyst appeared yellow and leathery and showed numerous calcific deposits. This inner layer was pretty tough and could be stripped off from the outer fibrous layers. In the wall of the cyst c an irregular nodule d about the size of a hen's egg was seen. This was covered by tough connective tissue and showed numerous small calcific deposits on its outer surface. It was quite hard and proved to be a teratoma which on section was very firm and nearly solid. Its color was reddish and the tumor gave the impression of being composed of muscle and fibrous connective tissue. A cyst e about the size of a large marble was also present. Its wall was smooth and calcified about a millimeter thick. From the periphery of this cyst a nodule f looking like cartilage and about the size of a pea protruded into the substance of the

above described teratoma. At another point of the cyst wall e a nodule g in every way similar to f was seen. At the side of the teratoma d there was a bluish mass about the size of a large filbert s. This also showed areas of calcification both on the surface and in its walls. On section it showed the typical structure of a cystic goiter duplicating the macroscopic picture of the sectioned nodule s in Figure 1 (Case 1). One half of the nodule (struma s<sup>1</sup>) did not show much colloid and in some places cartilage like structures were present. Near the poles of the teratoma and in the cyst wall surrounding d there were very hard closely adherent struma like nodules s which differed from s<sup>1</sup> only in being smaller. The cyst walls of a and c formed only a loose covering over the struma. One may perhaps be surprised at the number of struma nodules (seven altogether) present in this tumor but multicentrally developed tumors do occur and multiple dermoids have been described for instance by Wilms. It is also possible that some of the nodules may have been metastases.

The left ovary was cystic about as large as a hen's egg, and showed only small remnants of ovarian tissue around the hilus. The left tube was slightly thickened but otherwise normal.

As in the first case a chemical examination for iodine was carried out but again was negative. The watery clear fluid content of the main cyst and the colloid of the struma were examined for pseudomucin also with a negative result. The fluid contents of the other cysts were no longer available at the time of the pathological examination.

*Microscopic description.* Numerous pieces of tissue were excised from different parts of the cyst wall

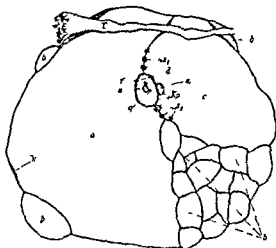


Fig 5 Diagram of tumor in Case 2. *a* Main cyst. *b* daughter cyst. *c* cyst size of orange. *d* teratoma. *e* calcified cyst. *f* and *g* cartilage like bodies. *h* main struma nodule. *i* other small struma nodule. *j* tube. *k* calcified area. *kp* capsule formed by walls of cysts *a* and *c* and loosely attached to the various tumor.

and the various solid tumors. Serial sections were as in the first case impossible because of the density of the colloid material and one had to be satisfied with numerous sections taken at different levels. Cyst *e* and the surrounding tissues were decalcified and embedded in celloidin and the other tissues in paraffin. Sections were stained with hæmatoxylin and eosin, Van Gieson's stain and with hæmalum for glycogen according to the method advocated by I. Meyer.

Sections from the struma like areas of the second case showed microscopically just as in the first case the typical structure of a cystic goiter. Here too parvicellular or even hyaline connective tissue areas separated the various colloid filled cysts. In the thicker fibrous bands lymph spaces were present and sometimes calcified areas.

Although the above was the general picture, some sections showed interspersed with the struma tissue large areas of lightly staining polygonal cells with small rounded nuclei (Fig 6). These light cells on first sight resembled the Langhans decidual cells described by Pick in his epithelioma chorioectodermale and in some places even showed a slightly alveolar arrangement, similar to that present in the syncytial structures in Pick's cases. Moenkeberg, however, believes the tumor described by Pick to have been of endothelial origin and it is to be admitted that our cells

in their arrangement did resemble somewhat an endothelioma or more exactly a perithelioma (Fig 6), since they seemed to be arranged around the vessels. Nevertheless, endotheliomata of the ovary, although they have been described (Burckhardt, Schlagenhauser, etc.), are rare and the cells in our case if we were really dealing with an endothelioma would then have to have been derived from the endothelium of the vessels. This, however, seemed unlikely as no connection between the described large light cells and the vessel walls which were everywhere distinct and separate could be seen.

These large light cell areas likewise did not resemble a carcinoma (Michel interprets Pick's epithelioma chorioectodermale as a carcinoma), since evidence of malignancy could nowhere be detected. A hypernephroma or renal tumor seemed also histologically impossible. The more we studied these cells the more they seemed to us to resemble the parathyroids especially in view of the fact that in some areas these light cells were surrounded directly by the struma and thus presented a picture similar to that seen in a struma colli which has engulfed a parathyroid gland. Such an occurrence is rather rare in goiters of the neck but mixed tumors which are not subject to the usual normal restraints of growth can be expected to be more likely to present such heterotopically placed tissue. It is of course not surprising that these light cell areas in this tumor are not histologically easy to identify since they are made up of apparently still more or less embryonal and not fully ripened or differentiated cells.

The sections just described also showed near the center a darker spot about the size of a pinhead. Microscopically this area again showed the described polygonal cells except that these were stained more deeply and histologically gave the impression of being older. The cells formed an almost solid area which was entirely surrounded by the struma. Small blood vessels and fine connective tissue fibers were seen at the periphery of these cell masses and some fibrous tissue bands also passed between the individual rows of cells. These characteristics were especially prominent around the few hollow areas (artefacts).



Fig 6 The large cavities below and to the right are blood vessels. These are closely surrounded by the large light staining cells but no direct connections are visible between these light cells and the blood vessels. The large cavity on the left is an artefact (probably originally a small vessel). Some small thyroid cysts some of which contain colloid are also present. Below dense connective tissue is seen. Leitz ocular No 2 objective No 3.



Fig 7 Somewhat higher magnification of the cell masses seen in Figure 6. The cavities present here are nearly all artefacts. Below struma cysts and blood vessels are present. Leitz ocular No 2, objective No 6.

Paul von Baumgarten who was kind enough to study them, and who substantiated my diagnosis.

which were lined by broken and torn remnants of cells. The similarity of this whole area to parathyroid structure was very striking (Fig 7), slight differences in various cells being probably explainable on the basis of varying degrees of differentiation.

Numerous sections were now stained for glycogen (method of P Meyer) but with negative results. This may have been due to the formalin fixation. On the other hand, the cells here were definitely young cells and glycogen is found especially in older cells. Furthermore metaplasia may have played a role here. We now interpreted the previously described light cell masses as being of the same character as the ones last described and regarded them all as proliferations from one or more engulfed parathyroid glands analogous to a parastruma colli. Such a proliferation may have been synchronous with the struma growth or secondary in reaction to the stimulus given by the thyroid tissue.

Since I feared that subjectivity might lead me to interpret these cells as of parathyroid origin I submitted my sections to Professor

The next slides examined (piece from teratoma *d*, near the calcified cyst *e*) showed a part of what macroscopically was thought to be cartilage. It was found however to be only hyaline connective tissue with some areas of calcification. The rest of the specimen again consisted of typical struma also containing areas of the described light cells. Another piece of tissue likewise showed struma, but more fibrous connective tissue and muscle. The latter was invaded to a greater or lesser extent by the struma but the histological picture of malignancy was lacking. The light cell areas were here also seen and seemed at times to change gradually but directly into struma tissue (according to Blum cited by Biedl. Internal Secretion: transitions of the cells of the two organs do occur).

The sections containing the original calcified cyst *e* (Figure 5) were examined next. The wall of the cyst was composed of dense hyaline connective tissue with one area slightly resembling bone. True bone however was not seen. The main portions of the sections were again made up of struma which here also invaded slightly the surrounding fibromuscular tissue. On one side of the section but separated from the struma by dense connective tissue there was typical salivary gland. Such tissue has been previously found in teratoma.<sup>1</sup>



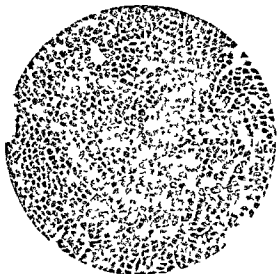


Fig 8 Portion of the tumor with the appearance of salivary gland tissue. Below and on the left there are indications of excretory ducts (radially arranged slits). Some blood vessels also are seen in the tumor. Its lobular structure is not apparent in the figure because the microscopic field was too small to show it. Leitz ocular No. 2 objective No. 3.

The salivary gland tissue in our case was divided into lobules by connective tissue bands, while finer bands split up the lobules into acini. There were no typical ducts, but indications of the same were seen (Fig. 8).

Sections from the cyst walls showed the same structure as those from the cysts *a* and *b* in the first case. No epithelial lining was visible and no ovarian tissue.

In the second case also the capsule was only loosely connected to the teratoma and the struma nodules. The leathery interior layer of the one cyst consisted of hyaline connective tissue in which blood pigment deposits were present.

Tubular structures and surface invaginations, such as Bauer described, were nowhere even as much as indicated. The fallopian tube showed chronic inflammation. The cyst of the left ovary was unilocular; the walls composed of thin connective tissue and the epithelial lining flat and non ciliated. Near the hilus remnants of apparently functioning ovarian tissue were seen.

Cases such as the two here described speak strongly against Bauer's conception that all

the cases described as struma ovarii are in reality unusual pseudomucinous cysts. In neither one of the two cases was pseudomucin found chemically in any of the cyst contents, and certainly the first case was morphologically not at all like a pseudomucinous cyst. Both cases were teratomata and the second contained what apparently was parathyroid tissue. In fact even trachea and bronchi have been found in close association with the strumateous portions of an ovarian tumor (see my previous article). Gottschalk has also demonstrated<sup>1</sup> a dermoid derived apparently not from the ovary but from the pelvic connective tissue which contained a struma. Following my article Simona and Kafka have likewise offered objections to Bauer's view. Kraus, and especially Kafka have used special methods of staining (Unna's acid, fuchsin tannic acid solution and polychrome methylene blue) to identify colloid of which they have shown three forms (fuchsinophilic, fuchsinophobic, and tannic acid fast). We have found the same three colloid forms in struma ovarii cases. At the same time it must be mentioned that Wail has denied the correctness of the interpretation of Kraus' staining reactions. While it is true that Kraus has answered Wail<sup>2</sup> and it is also true that Robert Meyer and also Schauta have found iodine in ovarian thyroid tissue and Kaufmann himself<sup>3</sup> still recognizes struma ovarii as a form of teratoma and states that only at times may it be closely simulated by a pseudomucinous cystoma ovarii, there still remains a certain amount of doubt as to whether or not we are actually dealing in this form of ovarian tumor with true thyroid tissue. Such doubts can be finally allayed only by cases in which the struma ovarii really is functionally active. I do not stress the fact that both of my cases had a struma colli since goiters are so very frequent in some parts of southern Germany. For the same reason I do not rate very highly other cases of struma ovarii associated with struma colli (see Walthard, cases 1 and 3, Kretschmer, and Bell case 2 and others), and I cannot

<sup>1</sup> *Ger. Gyn. Soc. meeting* Ges. 11, 1902.

<sup>2</sup> *A. H. F. p. th. Anat.* 223, ccxlv, 1909.

<sup>3</sup> *His article appeared from Ka. fmann laboratory.*

necessarily consider Morgen's first case in which an atrophy of the thyroid gland with out symptoms of myxœdema, and a struma coli were present together as very convincing since such atrophy need not necessarily be interrelated with a tumor of the ovary, and even a small amount of thyroid tissue left in the atrophic gland may prevent symptoms of myxœdema. From the morphological standpoint Morgen's cases, especially the second one, are however, quite convincing.

There are nevertheless some cases in the literature in which the struma ovarii may perhaps have functioned. Trapl extirpated a struma ovarii after which due to thyroid enlargement, the patient's neck grew from less than 32 centimeters in circumference at the time of operation to 33.5 centimeters 9 months after operation. For a time a quickened pulse and a tremor of the extended fingers were also present. The patient was otherwise normal and her genital organs were negative. Whether we can attribute the described changes here to thyroid activity following the removal of functioning thyroid tissue in the ovary is nevertheless somewhat doubtful.

Kovacs, however, described a case which seemed to present real evidence that functioning thyroid tissue was present in the ovary. The patient had a struma ovarii both morphologically and chemically and in addition, signs of exophthalmic goiter at the time of operation. The symptoms all disappeared after the removal of the tumor. This case is the only one of its kind that I have been able to find in the literature. It is interesting therefore that recently I saw another case of struma ovarii in which a functional activity of the ovarian thyroid tissue at least seems to have occurred.

This patient M. B. private case was seen by me at my office August 20, 1927. She was 49 years old, a housewife, married 32 years. Family history was negative. The woman had had 6 children, 30 to 20 years ago and 2 induced abortions 8 and 6 years ago. Menstruation had always been rather scanty and occurred only every 6 to 8 weeks. Last period was 2 years ago. Constipation of rather marked degree was present.

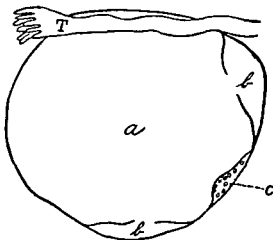


Fig. 9. Diagram of tumor of Case 3. *a* Main cyst. *b* daughter cysts communicating with main cyst. *c* thickened portion of cyst wall with teratomatous nodule. *T* tube.

For the last year the patient had had pains in the right side of her abdomen and frequent urination. These symptoms were gradually becoming worse and the abdomen was increasing in size.

General examination disclosed a short stout woman, with large fat somewhat tense abdomen. The lungs were normal. The heart was normal in size and the heart sounds were irregular in rhythm and quality, and extrasystoles occurred from time to time. There were fine tremors of the fingers. The tongue was negative and showed no tremor. Urine was negative. Blood pressure was 154-95 mm Hg. I regarded the heart lesion as functional and the internist who was consulted confirmed this.

**Gynecological examination.** The abdomen was fat and rather tense. In it a cystic movable mass about the size of a honey dew melon could be felt. The external genitals were negative except for a somewhat relaxed pelvic floor and a slight cystocele and rectocele. The cervix above the interspinous line showed an old healed laceration. The uterus was small and ante flexed. The left adnexa were normal, the right could not be felt but the cystic tumor described above lay mainly on this side.

**Diagnosis.** Right sided ovarian cyst.

Laparotomy was performed a few days later and the ovarian cyst and right tube were removed intact without any difficulty and the stump peritonized. The patient stood the operation well and made an uneventful recovery except for a very interesting change in her heart. On making rounds 2 days after the operation I noticed that the pulse seemed more regular than before and an examination of the heart confirmed this opinion. The pathological examination of the tumor at this time was not yet finished and I burned it as much as possible. Three days



Fig 10 Thickened portion of cyst wall Above is seen the fibrous connective tissue forming the wall of the main cyst Below is struma tissue The large clefts in the picture are artefacts Leitz ocular No 2 objective No 3



Fig 11 Nodule of tumor projecting into lumen of main cyst Above teratomatous constituents and above that is seen the lining of the inner surface of the cyst which at the left passes into the stratified squamous cell epithelium present in this area Below again is struma tissue Leitz ocular No 2 objective No 3

later that is 5 days after the operation the heart was perfectly normal in its action, and the consulting internist 2 days later corroborated this. The tremor of the fingers was now also much less marked.

The pathological examination showed an ovarian cyst with thyroid tissue in it. We regretted exceedingly that we had not done a basal metabolism test on the patient but this omission is I believe to be pardoned as one ordinarily does not think of doing such a test in an otherwise simple ovarian cyst case.

The pathological examination showed the following:

**Macroscopic description.** The specimen consisted of an ovarian cyst and attached fallopian tube (Fig 9). The cyst was smooth on the surface and measured 16.8 by 16.5 by 9.2 centimeters. On section the contents were watery thin and of a straw color. The cyst was in the main unilocular (a, Fig 9) but had some daughter cysts (b, Fig 9) which however were in communication with the main cyst. The cyst wall was fibrous and fairly thin in most places. At one place (c, Fig 9) however the cyst wall was 1.5 millimeters thick. At this point a small nodule the size of a filbert and discolored by hemorrhagic infiltration was seen. On section this nodule contained numerous small cysts filled with a brownish red material which suggested colloid of thyroid origin. The thickened area of the cyst wall on section was made up in part of similar colloid-containing cysts.

The fallopian tube was 7.5 centimeters long and 0.7 to 1.2 centimeters in diameter. It was tortuous. The fimbriated extremity was patent.

**Microscopic examination.** Numerous sections were taken from various portions of the tumor especially from the described nodule and thickened portion of the cyst wall. They were embedded in paraffin in the usual way and stained with hematoxylin-eosin (H&E) and Gieson's stain and according to Kraus's method for colloid.

Sections from the cyst wall showed it to be composed of dense fibrous connective tissue with some small blood vessels and a few lymph spaces. The epithelial lining had been lost in some places but other areas showed a low cuboidal epithelium with here and there a few cilia. The sections from the thickened area of the cyst c apparently represented the original area about the hilus of the ovary. Remnants of ovarian cortex with a few immature follicles and numerous corpora albicantia were here visible. The stroma was rather lightly packed together and showed areas of rarefaction (Figs 10 and 11). Many small and some larger blood vessels and lymph spaces were present.

Toward the interior of the thickened area there was a flattened nodule which was composed of numerous cysts of varying size. Some were filled with rather dense masses of secretion which stained red with eosin. Other cysts were bare of this colloid-like secretion. The epithelium everywhere was cuboidal usually somewhat higher in the small cysts than in the larger ones. The intervening stroma showed occasional collections of round cells and lymphocytes arranged more or less in the shape of follicles (Fig 10). Some of the cysts showed at their

peripheries solid buds of cells others showed these buds with a small lumen of their own. In some of the larger alveoli there were knob like excrescences and protrusions into the lumen the epithelium here being higher than in other places. The cysts often also showed extravasated red blood cells desquamated epithelial cells and various types of pigment haemofuscin and iron pigment. The described nodule which protruded into the lumen of the large cyst (a, Fig 9) on section showed a structure similar to the one just described. In addition there were numerous hair follicles and sebaceous glands present. The surface of the nodule was covered by stratified squamous epithelium which in some areas was cornified and went over into the columnar epithelium lining the large cyst cavity (Fig 11). This thickened area in the cyst wall was therefore a teratoma or dermoid containing what appeared to be typical thyroid tissue and resembling a toxic goiter in the resting stage. Further staining reactions according to the method of Kraus also showed all three forms of colloid (fuchsinophilic fuchsinophobio, and tannic acid fast) to be present. A chemical test for iodine was however negative. Due to the press of work the contents of the large cyst were not examined but the whole morphology of the tumor excludes with certainty a pseudomucinous cyst.

The fallopian tube showed a congested thickened wall with a slight chronic inflammatory reaction.

The follow up of the patient showed her to be in excellent health 3 months 6 months and 13 months after operation. The heart has remained perfectly normal in rhythm and quality.

We have here then a third tumor certainly not a pseudomucinous cyst containing thyroid tissue. Since the tumor was too small to have caused irregular heart action from pressure and an ovarian cyst in itself does not disturb heart action and since the rest in bed cannot be considered to have returned the patient's heart action to normal as this has remained so ever since, it is perhaps not too far fetched to attribute the change in the heart action to the removal of actually toxic thyroid tissue contained in the ovarian tumor. There is at any rate no other assignable reason for such a change and the case shows how comparatively small an amount of thyroid can influence metabolism.

#### SUMMARY

In view of these 3 cases especially the last one which seems to have contained actually

functioning thyroid tissue, we must deny Bauer's assumption that cases of struma ovarii are really pseudomucinous ovarian cysts or even cystadenomata ovarii at all. They are teratomata perhaps not so rare as commonly supposed, but extremely rare as far as actual functioning of the thyroid tissue is concerned this being only the second tumor described in the literature in which the assumption of functionally active thyroid tissue in an ovarian teratoma seems really justified.

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THE PATTERN OF SENSORY RECOVERY IN PERIPHERAL NERVE LESIONS<sup>1</sup>

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ONLY scanty references to the pattern of sensory recovery, often incomplete and faulty, may be found in the literature dealing with injuries to the peripheral nerves. Comparing the sensory charts of complete lesions with those of recovering ones some interesting observations have been made which merit description.

For many years it has been noted that the total loss of sensation is limited to a much smaller area than one would expect from its anatomical distribution. It has been well recognized that the residual sensibility of a nerve is more extensive than its accepted anatomical distribution.

It has likewise been noted that about 50 days or so following suture of a nerve, the area of analgesia begins to shrink. This early return of sensibility to pain has been attributed to an early regeneration of protopathic fibers.

In some previous publications I stated my opinion that this early and dissociated return of sensibility to pain is due to the assumption of function of adjacent uninjured nerves. It is felt that this is true because first the return of sensibility to pain always occurred in certain areas of skin supplied by the various nerves. Second, when one or more adjacent nerves were injured simultaneously sensibility to pain never returned in the borders between these nerves where it usually returned when either of these nerves was injured alone. Third, when there was a return of sensibility to pain in a region of sensory distribution of a severed nerve this region became analgesic when an adjacent nerve was severed for example to be used as a cable transplant. Fourth when sensibility to pain had returned in a region in the area of sensory distribution of a severed nerve subsequent resection and suture of this nerve was not followed by a loss of this sensation.

The return of sensibility to pain in such cases follows a pattern so characteristic that it may be recognized at sight. It never returns in the distal phalanges of the little finger in ulnar nerve lesions, never in the distal phalanges of the index and middle fingers in median nerve lesions, and so on. It always occurs along the borders of an uninjured nerve and may well be described as a shrink age (Fig. 1).

Contrasted with this, the pattern in recovering nerves is strikingly different. Although shrinkage occurs, other changes are always present. A certain degree of standardization is necessary, if the observations of one investigator are to be utilized by another.

Examination for tactile sense is now generally done by means of a wisp of cotton care being taken to shave hairy parts. In the examination here recorded, cold sense was detected by means of a wisp of cotton moistened with ether. This procedure permitted rapid examination of closely adjacent areas of skin and a gradient of sensory loss could be easily estimated. It was noted in our study that in complete lesions the area of loss of cold sense thus examined was practically co-extensive with tactile anesthesia. Frequently the border was slightly outside that of touch. Little overlap for this degree of cold was ever noted. It has been stated that if one examines for analgesia with low degrees of pressure, 15 grams the area of analgesia will be co-extensive with that of touch and if increasingly greater pressure be used, the area will shrink and give rise to fallacious interpretation of return of pain sense. This may be true, but it is well to remember that if any sensation to pain is present it can only be the result of regeneration of the injured nerve or assumption of function of an adjacent uninjured nerve. Therefore return of sensibility to pain in the isolated supply of a nerve is evidence of regeneration, however great the pressure used to test pain sense.

<sup>1</sup>POLLOCK, LEWIS J. Overlap of so-called protopathic sensibility as seen in peripheral nerve lesions. Arch. Neurol. & Psychiat. 1919 11 667-700.

<sup>2</sup>From the Department of Nervous and Mental Diseases, Northwestern University Medical School, Chicago. Read at a meeting of the Chicago Neurological Society, December 19, 1925.

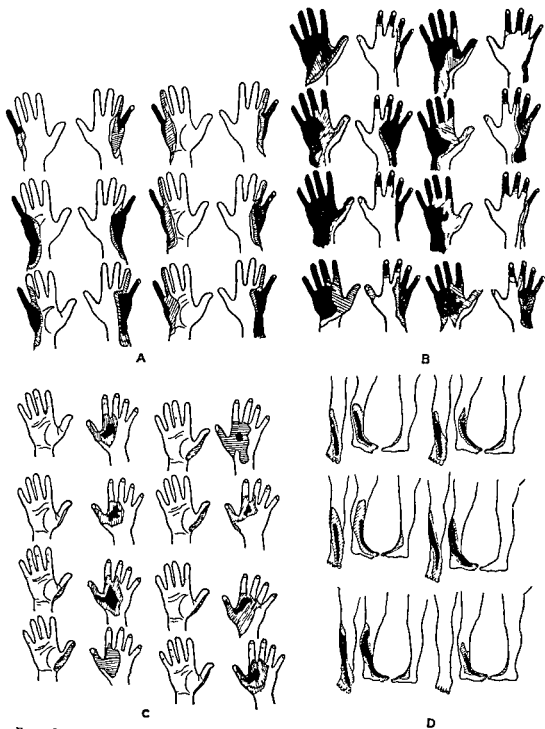


FIG. 1. Sensory loss in complete section of A ulnar nerve B ulnar and median nerves C radial nerve D external popliteal. Black loss of pain touch and temperature shading loss of touch.

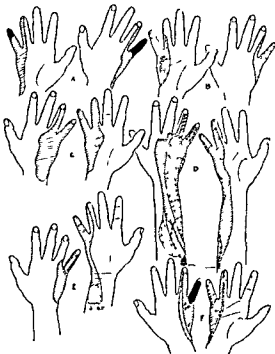


Fig 2 Ulnar spontaneously recovering A Rare severe isolated marked sensory loss B recovery of pain in isolated supply diminished loss of touch C recovery of pain D recovery of pain in isolated supply recovery of cold E recovery of patch of pain and touch F diminished loss of pain in isolated supply recovery of touch G loss of pain touch and temperature shading loss of touch circles loss of temperature letter S hypaesthesia letter Y analgesia hash (#) scratch

Inasmuch as pain elicited by greater degrees of pressure often returns before tactile sense, and probably the co extensive loss of pain sense to very light degrees of pressure, it cannot be emphasized too strongly that although lighter degrees of pressure accurately recorded by an algometer should be used in studying sensory loss, one should never neglect to use greater degrees of pressure. The charts of the material here studied represent the analgesia obtained with 30 grams of pressure.

The material consisted of about 400 cases. The general conclusions are derived from the whole material, from which has been selected a number of cases recovering after operation contrasted with those recovering spontaneously. No difference could be detected between the cases recovering following neurolysis and resection and suture, except in

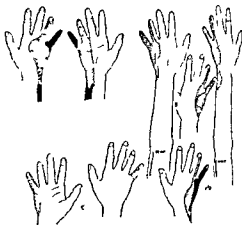


Fig 3 Ulnar postoperative A Extensive sensory loss motor recovery B diminished loss of pain C patchy recovery of touch and complete recovery of pain D recovery of pain in isolated supply of nerve E loss of pain touch and temperature shading loss of touch circles loss of temperature letter S hypaesthesia letter Y analgesia hash (#) scratch

those in which prior to the neurolysis the sensory loss did not occupy completely the sensory cutaneous distribution of the nerve. Here very early return of function in the partly anæsthetic or analgesic area was found.

Ulnar nerve lesions in general showed a larger number with little sensory recovery when motor recovery had begun.

In those spontaneously recovering, recovery of pain sense as well as diminution of degree of analgesia in the isolated sensory supply of the nerve was frequently noted. Return of pain and touch in patches occurred. Areas of return of pain and cold and persistent anaesthesia were noted. Almost complete return of sensation to cold with anaesthesia and analgesia was observed. In the cases recovering following operation the loss to pain sense was generally greater, the same general characteristics were found. Particularly interesting were the areas of recovery of tactile sense in indentations and fissures (Figs 2 and 3).

Median nerve lesions spontaneously recovering showed in a number of instances areas of return of sensibility to touch and not to cold. More frequently, cold had returned in areas whereas touch had not. Interlacing of the border of loss of cold was seen. Patchy return of tactile sense and pain sense was

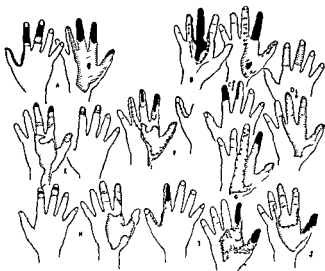


Fig 4 Median spontaneous recovery A Motor recovery severe sensory loss B unusual distribution of sensory loss C recovery of touch not pain or cold D recovery of pain and cold not touch E patchy recovery of touch F patchy recovery of touch G recovery of touch and pain not cold H patchy recovery of touch complete recovery of pain and cold I recovery of touch and pain not cold J recovery of cold not touch Black loss of pain touch and temperature shading loss of touch circles loss of temperature letter A analgesia, letter S hypæsthesia

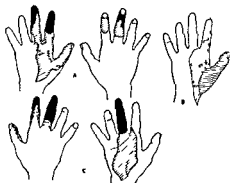


Fig 5 Median postoperative A Slight interlacing of cold recovery of cold not touch end to end suture B nodule excised recovery of pain in isolated supply diminished tactile loss C neurolysis no analgesia or anaesthesia of index finger Black loss of pain touch and temperature shading loss of touch circles loss of temperature letter S hypæsthesia letter A, analgesia

observed. Partial lesions often showed sensory loss of only part of the sensory supply of the nerve. As a rule, the cases recovering after operation showed less recovery to pain. When motor recovery had begun, sensory recovery could often be seen (Figs 4 and 5).

Radial nerve lesions in many instances showed areas of loss of cold with recovery of tactile sensation. In lesions of this nerve, the return of sensibility to pain alone cannot be given much weight in relation to regeneration, because of the very wide overlap of adjacent nerves. Patchy return of sensation, interlacing of the borders of loss to cold areas of recovery of tactile sense and not of cold and the reverse, as well as the recovery of tactile sense in the sensory supply of the nerve served to determine the existence of a process of recovery. In some cases a widespread anaesthesia was present, but a deep indentation (Fig 6A) pointed to a correct diagnosis. Similarly (Fig 8C), a wide anaesthesia and analgesia would have been deceptive had not the border of the loss to cold been well out

side this area, and interlacing of cold been present (Figs 6 and 7).

Combined ulnar and median nerve lesions illustrated very well the return of sensibility

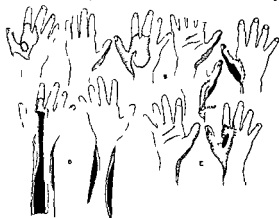


Fig 6 Radial spontaneously recovering A Recovery of pain, small area of loss of cold B recovery of pain and cold C injury of superficial sensory nerve recovery of touch, not pain D recovery of all motor branches marked sensory loss E recovery of cold not touch Black loss of pain touch and temperature shading loss of touch circles loss of temperature letter Y analgesia



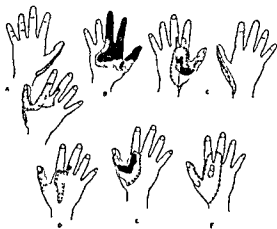


Fig 7 Radial postoperative A Return of pain not cold B radial and median showing considerable analgesia C recovery of touch not cold touch not pain D return of touch not pain in a patch the shaded area showed only tactile hypæsthesia E return of touch not pain or cold F recovery of touch and pain not of cold G Black loss of pain touch and temperature shading loss of touch circles loss of temperature letter Y analgesia

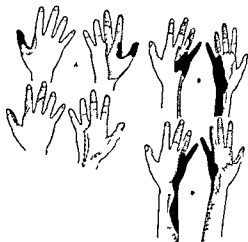


Fig 8 Ulnar and median spontaneously recovering A Complete recovery of ulnar recovery of pain in isolated area of median and diminished tactile loss B ulnar marked sensory loss median recovery of pain touch and temperature sense in isolated supply C ulnar recovery No loss of pain in median marked loss of cold D recovery of cold and temperature sense in isolated supply of median E Black loss of pain touch temperature shading of touch circles of temperature F hypæsthesia G analgesia

in the area between the borders of their respective sensory supply, which never occurs in complete lesions Interlacing, patchy return, return of sensibility in areas of isolated

sensory supply, dissociation of loss to cold and anaesthesia occurred (Figs 9 and 13)

Brachial plexus lesions showed all of the mentioned characteristics Patchy recovery



Fig 9 Ulnar and median postoperative recovery A Return of sensation in area between injured nerves B Ulnar only neurolysis median section suture return of pain not cold C median only neurolysis ulnar section and suture patchy return of pain in ulnar D Black loss of pain touch and temperature shading loss of touch circles loss of temperature letter S hypæsthesia letter Y analgesia



Fig 10 Brachial plexus A Patch of return of pain in isolated supply recovery between adjacent nerves B recovery of pain not touch C recovery of touch, not cold patchy return of touch D interlacing of loss of cold E Return of touch in isolated supply F Recovery of touch not cold G Black loss of pain touch, and temperature shading loss of touch circles loss of temperature H analgesia

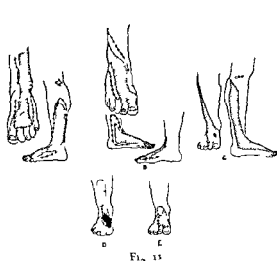


Fig. 11

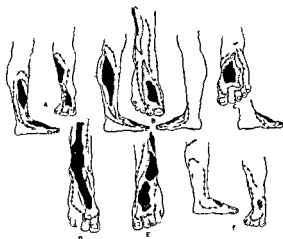


Fig. 12



Fig. 13

Fig. 11 External popliteal spontaneous recovery. A Recovery of pain interlacing of cold B recovery of pain C diminished area of loss of pain D recovery of touch and cold not pain E recovery of touch not pain Black, loss of pain touch and temperature shading loss of touch circles loss of temperature letter S hypæsthesia letter Y analgesia

Fig. 12 External popliteal, postoperative. A Patchy return of pain B patchy return of pain and touch primary suture C return of touch in area of isolated supply D recovery of cold great toe interlacing E patchy return of pain interlacing I recovery of touch not cold Black loss of pain touch temperature shading of touch circles of temperature letter S hypæsthesia letter Y analgesia

Fig. 13 Sciatic spontaneously recovering. A, Extensive sensory loss marked motor recovery B recovery of pain internal popliteal with wide area of loss in external popliteal C recovery of touch patchy not cold D recovery of touch not pain interlacing of cold E recovery of pain in isolated supply cold in patches F complete recovery external popliteal and of pain in internal popliteal G patchy recovery of pain in internal popliteal recovery of external popliteal H recovery of touch and pain not cold patchy recovery of touch The black area indicates loss of pain touch and temperature shading loss of touch circle loss of temperature letter S hypæsthesia letter Y analgesia

was well illustrated, as well as recovery to touch and not to cold and interlacing of borders of loss of cold (Fig. 10)

External popliteal nerve lesions spontaneously recovering frequently showed complete recovery to pain. Interlacing of the border of

loss of cold was seen, particularly over the dorsum of the foot. Areas of recovery to touch and not to pain or cold were occasionally observed. In the patients recovering following operation, loss of pain sense was more common. Here patchy return of pain sense



Fig 14 Sciatic postoperative A Recovery of pain and cold in area of internal popliteal B return of sensation in internal popliteal patchy return of pain interlacing of cold C marked return of pain D return of pain in external popliteal patchy return in internal popliteal cold not recorded E return of pain in internal popliteal diminished loss of touch. Black loss of pain touch, and temperature shading loss of touch circles loss of temperature letter S, hypaesthesia letter h analgesia

was very frequently observed Interlacing areas recovery of touch and not of cold, as was the case in the radial nerve, were noted (Figs 11 and 12)

Sciatic nerve lesions spontaneously recovering showed at times marked sensory loss with good motor recovery Recovery of pain sense only in the area supplied either by the internal popliteal or external popliteal occurred frequently Where sensation was returning to the sole, areas of recovery to touch and pain with loss to cold sense were seen Areas of recovery to touch and not to cold were also observed over the leg Where sensation had partly returned in the area supplied by the internal popliteal, the area of analgesia in the region supplied by the external popliteal occurred

in a wider area than is seen in isolated lesions of the external popliteal Recovery by indentation and patches, both of touch and pain, occurred

In patients recovering following operation, generally the loss of pain was more extensive When partial recovery had taken place in the areas supplied by the internal popliteal the sensory loss produced by the lesion of the external popliteal was very extensive When one or other divisions of this nerve showed unequal regeneration, this condition was found to be the result of a lesser injury to the part first recovering (Figs 13 and 14)

#### SUMMARY

The characteristic features of the sensory loss of regenerating nerves may be enumerated as follows

Return of sensibility to pain, touch or temperature sense in that area of the sensory distribution of a nerve which is supplied by it alone, i.e., the isolated sensory area of the nerve

Return of sensibility to pain, touch or temperature sense in patches some distance from the area supplied by an adjacent uninjured nerve

Return of sensibility to pain, touch or temperature sense in deep indentation

Diminution of degree of loss of sensation of pain touch, or temperature sense in the isolated sensory supply of a nerve

Return of sensation of pain, touch, or temperature in the border between the sensory supply of two nerves simultaneously injured

Interlacing of the border of sensory loss of one type of sensation with that of another

## CLINICAL AND EXPERIMENTAL STUDIES OF PULMONARY INFLAMMATION FOLLOWING INFLAMMATIONS OF THE BILE DUCTS AND GALL BLADDER

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IT has only lately been recognized that lung and bronchial inflammations very often follow biliary tract infections, although for some time it has been observed that both inflammatory processes may co-exist. In such cases one usually finds that the primary disease is in the chest and that the biliary tract inflammation appears only as an accompaniment of the pneumonia, for it is already known that biliary tract infections may be caused by pneumonia.

How often the reverse of this holds true has only recently been recognized by Bahrdrf Wilkie, and others. From 1921 to 1924 we observed 7 cases, not only clinically but also experimentally, which showed this reversed course. Concerning the occurrence of pulmonary complications following biliary tract inflammations little has heretofore been written. Mosse (1889), Sterne (1885), and Parisot (1905) showed that often the presence of cholelithiasis without marked symptoms is masked by the presence of the secondary pneumonia in the right lung. In 1905 Kehr noted that right sided pneumonia often appeared with gall stone symptoms and disappeared immediately after operation. In 1913 Bahrdrf wrote "It is never difficult to diagnose cholangitis or cholecystitis if the symptoms are definite, but on the other hand it is quite difficult if there is also present a pneumonia or bronchitis with high fever." Wilkie showed that biliary tract disease which gives no marked symptoms and which is accompanied by a severe pneumonia or bronchitis, is nearly always diagnosed only as the pulmonary disease.

CASE 1.—A 28 years old railway official complained of marked epigastric pain. Previous history negative. On June 27, 1921 the patient suffered sudden severe epigastric pain associated with some nausea but no vomiting or chills. The next morning the pains had decreased but the patient remained weak, had no appetite and had a feeling of fullness in the epigastrium. Towards midday

the pain extended to the right hypochondrium, became more severe, radiated to the back and to the shoulder blade, and there appeared on the body a yellowish discoloration. The temperature was 38.1 degrees C. Patient was of medium height and had an expression of pain. The tongue was moist and coated, skin icteric. Pulse regular, 85 per minute, tension somewhat weak. Respirations regular, 20 per minute. Temperature 38.5 degrees C. Lungs and heart were negative. The liver was felt two finger breadths below the costal margin, under the liver one could feel the gall bladder, about the size of a hen's egg, very painful to pressure and evidently quite tense. The upper part of the right rectus abdominis muscle was rigid, stomach and intestines were negative. The urine was markedly yellow, Gmelin reaction positive, stools the usual color, a few ascaris eggs seen.

From the above findings we made the diagnosis of acute cholecystitis and treated the case accordingly. On the next day the hypochondrial pain extended over to the right side and the patient began to cough. At the right base râles were heard, temperature, respiration and pulse as before. The gall bladder was still palpable and very tender. On the following day (July 1) the hypochondrial pain was somewhat less but still present on palpation. The cough had increased, râles were heard at both bases, and on percussion a muffled tympanic note was obtained, vocal fremitus was increased. Temperature 38.8 degrees C, pulse 100, respiration 26. We made the diagnosis of a complicating acute pneumonia. On July 3, the pain in the epigastrium had decreased even upon pressure, the gall bladder and liver were hardly felt. At the lung bases there was dullness upon percussion and many râles were heard, there was abundant sputum and considerable cough. On the seventh of July, the patient felt much better, the râles and dullness had decreased and there was no pain upon pressure in the gall bladder region. The temperature and pulse were normal and there remained only a marked jaundice of the whole body.

In this case we felt that there was a causal relationship between the two conditions and that the pneumonia followed the acute cholecystitis, since in the beginning the biliary infection was the more marked, and also because while the cholecystitis was at its height the chest findings were negative and after the subsidence of the abdominal findings the pneumonia became so marked.

**CASE 2** —T—, male 28 years old a merchant complained of pain and a feeling of fullness in the epigastrium especially after meals. Seven or 8 years earlier the patient complained of sudden severe epigastric pain, chills and high fever which kept him in bed for 2 weeks. He was unable to remember whether or not he was jaundiced at this time. Present illness began about the middle of January when he again suffered sudden severe epigastric pains which now radiated toward the right chest and were accompanied by high fever and vomiting. For the next 2 months these recurred frequently and after meals he noticed a dull pain in the epigastrium. During the time when he was free from pain, he had a feeling of fullness and pressure in the stomach region. Physical examination (April 10 1921) Patient was of medium height, his skin was clear pulse regular, temperature 36.5 degrees C. In the epigastrium the edge of the liver was felt one finger breadth below the costal margin. Under the liver edge and in the region of the lateral edge of the right rectus abdominis muscle there was felt the distended gall bladder which was quite painful to pressure. X-ray examination of the stomach and intestines was negative. Blood urine, stools and gastric analyses were negative.

In this case we made the diagnosis of chronic cholecystitis and planned to operate on the eighth of April. On the preceding evening a cathartic was given to the patient and after taking it he complained of marked epigastric pain and severe chills. His temperature at the time was 39.2 degrees C. On the following morning his temperature fell to 37.2 degrees C and the pains had decreased somewhat. He began to cough. There were dullness, many rales, and marked vocal fremitus at the right base. The patient's physician, who had treated him for a long time, stated that during his previous attacks these pneumatic symptoms often appeared and that it would be better to postpone this operation until the acute pulmonary signs decreased. We believed however that the pneumonia was secondary to the biliary infection and decided to operate under local anesthesia. When the peritoneal cavity was opened the liver was found to be somewhat swollen its surface a dark reddened color and its consistency somewhat firmer than normal. The gall bladder was a greenish white in color and was markedly adherent to the omentum and the duodenum. The common duct and the cystic duct were increased in size and their walls were thickened. No foreign bodies were felt the stomach and intestines were normal. The gall bladder after being removed was found to be filled with thick, tenacious greenish yellow bile, in which were many small sand like grains. For a few days after the operation there was considerable cough and hiccup but on the ninth day postoperative all chest symptoms had disappeared subjective as well as objective. The patient was discharged as well 4 weeks after operation.

This case seemed to show that the pneumonia or bronchitis occurring during an at-

tack of cholecystitis may be alleviated or cured by removing the primary source of infection.

**CASE 3** —K—, female aged 37 years house wife complained of a feeling of fullness in the epigastrium. Previous history was negative. Present illness began in September 1921, with sudden pain in the epigastrium which increased until February 1922 there were also chills and loss of appetite. During the times when she was free from attacks her appetite was very poor and the feeling of fullness in her stomach persisted. She was suspected of having a gastric ulcer and at another time was thought to be suffering from chronic bronchitis. Physical examination showed a small poorly nourished woman, pale, and with an expression of pain. Skin and mucous membranes anemic pulse 88 and regular, respirations 18 temperature 36.5 degrees C. The heart was normal, the lung liver border was at the sixth rib on the right the respiratory excursion was slight and at the right base there were dullness and crackling rales. The abdominal muscles on the right side were spastic and there was marked pain upon pressure. On the left side the muscles were quite soft. Under ether anesthesia an appendectomy was done. The appendix was free but the liver was markedly swollen increased in size, and came down about six fingerbreadths below the costal margin. The gall bladder was markedly enlarged and distended the upper surface was a grayish white in color and adherent to the surrounding organs. The bile ducts were normal. The wall of the gall bladder, which was then removed was very thick and the organ contained two stones, each about the size of a pea. Two weeks after the operation the patient was discharged as cured.

In this case we were able to recognize only at operation the biliary changes and at the same time to relieve the complications.

**CASE 4** —M—, male, aged 54 years gymnasium teacher complained of attacks of fever and epigastric pain. He had been ill at the age of 39. Present illness began in August 1921, with sudden severe chills and fever of 40 degrees C. These symptoms would recur after exertion and would last 2 or 3 days. By February, 1922 attacks of fever became more frequent and he always had a feeling of fullness and dull pain in the epigastrium. Physical examination disclosed a large man poorly nourished, with anxious facial expression, tongue coated skin and mucous membranes anemic but not icteric. Pulse regular, tension weak 75 per minute, respiration 18 temperature 36.5 degrees C. Heart was enlarged but there were no murmurs. In the right lung base there were moist rales but no dullness. In the epigastric region there was felt a mass about the size of a hen's egg the upper surface of which felt hard and uneven. This mass was only slightly mobile and was very painful upon pressure. Under the right costal

margin there was a hard circumscribed area felt upon pressure. Liver, spleen and kidneys were not palpable. Slight albuminuria occult blood in the stools. The gastric analysis showed a total acidity of 16 and no free acid. Hæmoglobin 38 per cent (Sahl). A diagnosis of carcinoma of the stomach was made. While in the hospital the patient had another attack of fever (40 degrees C), with severe chills and in both bases, but more especially the right many moist râles were heard. Six days later the chest symptoms had cleared up and the patient was operated upon. Besides the tumor of the stomach was found also a greatly enlarged gall bladder with markedly swollen lymph nodes at its duct end. The gall bladder and the tumor of the stomach were removed and a Billroth II operation was done. Postoperatively the pains in the stomach the attacks of fever, and the chest symptoms all disappeared but on account of increasing weakness and loss of appetite the patient died 4 weeks later.

This case showed us that besides the stomach carcinoma, a chronic cholecystitis which caused the fever and pulmonary symptoms was also present although unknown.

CASE 5 —T— male aged 47 years restaurant keeper complained of epigastric pain, cough and sputum. Since the age of 20 he has used alcohol habitually. His present illness began 2 years ago when he noticed a feeling of fullness and pressure in the epigastrium. Suddenly, in January, 1928 he was seized with an attack of vomiting and severe pain this was after some excess in drinking. The pain was most severe immediately after meals, this condition persisted for 4 months during which time his skin became jaundiced and he had a productive cough. He became markedly constipated sometimes going 4 or 5 days without a bowel movement. His appetite became very poor and he lost weight. He was thought by one physician to have carcinoma of the stomach and by another to have chronic bronchitis. Physical examination disclosed a man of medium stature, poorly nourished tongue coated skin and mucous membranes anæmic but not icteric. Pulse normal temperature 36.7 degrees C. Over both lungs anteriorly as well as posteriorly were heard many moist râles especially at the right base. In the epigastrium and extending into the right hypochondrium there was found upon pressure a resistant mass. The liver, kidneys and spleen were not felt. Gastric analysis revealed a total acidity of 5 no free hydrochloric and no lactic acid. X-ray examinations showed that there was some gastroptosis and an increase in the mediastinal shadow due to an increase in the peribronchial and hilus lymph nodes. The movement of the right side of the diaphragm upon deep inspiration was much less than normal. The sputum was thick and tenacious a grayish white in color, containing greenish areas microscopically it showed many cocci and diplococci. Inasmuch as the pulmonary symptoms were quite stubborn and since the patient was suspected of

harboring a carcinoma of the stomach it was decided to operate and not wait until the chest findings cleared up. The operation was performed under local anesthesia. The stomach was found to be greatly distended, but otherwise negative. The gall bladder was atrophic and its walls greatly thickened, its anterior surface was adherent to the stomach and the omentum. The gall bladder was freed of the adhesions and then massaged. After the operation the pulmonary signs gradually disappeared and the patient was discharged 4 weeks after operation as cured. Three months later we heard that the cough and sputum had returned but he was free from the epigastric pains.

In this case it was only at operation that the chronic cholecystitis and pericholecystitis were recognized, and we feel that if we had removed the gall bladder instead of only severing the adhesions, the cough and sputum would have been cured permanently as was the epigastric pain.

CASE 6 —Y—, female aged 50 years housewife, complained of jaundice and itching. Previous history was negative. Present illness began November 1921, when she noticed a dull pain in the right hypochondrium which was many times accompanied by chills. During a marked attack this pain radiated to the left chest and to the region of the shoulder and the temperature rose to 39 degrees C, in addition there was marked jaundice of the skin and a feeling of itching. Physical examination disclosed a woman of medium stature, poorly nourished tongue coated skin and mucous membranes greatly jaundiced. On the back, over her body there were several hemorrhagic areas about the size of a pea. Pulse 125 respiration normal temperature 37.2 degrees C. There was a systolic murmur at the apex. Upon percussion the lungs were negative, but upon auscultation many dry and moist râles were heard. The liver was enlarged and came down 1 fingerbreadth below the costal margin, its upper surface was smooth and somewhat painful. To the right of the epigastrium there was some muscle spasm. In the urine there was strong bile pigmentation the stools were clay colored. The sublimate test of Schmidt was markedly positive, as was also the test for occult blood. During the course of the 2 weeks observation in our clinic there was considerable cough and fever physical signs were always present in the chest the patient refused operation.

In this case the extensive jaundice and the hemorrhagic diathesis were the result of occlusion of the biliary ducts. One can also assume safely that the bronchitis and the endocarditis were also the result of this biliary occlusion, since no other possibility was present.

**CASE 7.** Male, aged 49 years school teacher, complained of epigastric pain after meals. Previous history was negative. About 10 years ago the patient had sudden severe pains in the right hypochondrium, accompanied by chills. Two years ago there was another similar attack and in addition fever and vomiting. During the periods when he was free from pain he noticed loss of appetite, weakness and abundant cough, jaundice was also sometimes noticed. Since March 1923 the pain had been present after meals. Physical examination showed the skin and mucous membranes jaundiced and somewhat anæmic. Pulse was normal temperature 36.0 degrees C. At the back on both sides dry and moist râles were heard and the breath sounds on the right were in general weaker than those on the left. Upon pressure the patient complained of pain under the right costal margin. Liver and gall bladder were not felt. The gastric contents were neutral. The urine gave a strongly positive test for bile pigment, stools were normal. By means of the duodenal tube we were unable to withdraw more than 15 cubic centimeters of clear yellow bile even after the addition of magnesium sulphate. The liver function test of *Widal* was positive. A diagnosis of cholelithiasis and cholecystitis was made and on June 5 1923 the patient was operated upon under local and para-vertebral anesthesia. The stomach and intestines were normal. The gall bladder was grayish white and the walls were thickened and hard as were also the bile ducts. The common duct was enlarged to the size of one's thumb and contained three polygonal stones. Cholecystectomy was done, the common duct was opened and the stones removed. The patient had an uneventful recovery.

In this patient the epigastric pain, cough and sputum were present in the beginning, and he was suspected of having a carcinoma of the stomach for a long time. From the previous cases we felt that this was one of biliary inflammation and this was shown to be the case at operation.

Of the above 7 cases, the first showed acute cholangitis which was the cause of the secondary pulmonary symptoms. In the other cases the cholecystitis or cholangitis was the primary disease process, although in comparison with the secondary pulmonary symptoms, the presence of biliary disease was hard to recognize. The sixth case was one of occlusion of the common duct through which a bilateral bronchitis was brought about.

Much has heretofore been written about the coincidence of cholangitis or cholecystitis with pneumonia and bronchitis but all the reports deal with those cases in which the pneumonia brought about the biliary infections and not

the opposite as we here describe. *Wilkie* alone has described 23 cases of primary acute cholangitis of which 12 developed secondary lung complications. Of 25 acute or chronic cases of cholangitis which we have observed 7 or 28 per cent, developed similar lung conditions, consequently, we might state from our experience that one should give more thought to this complication as it is present more often than has been assumed.

In biliary inflammations it is of great help to examine the respiratory movements on the right side by means of the X ray, as much for the diagnostic purpose as to explain the etiology. *Schuhlmeyer* (1905), in investigating the relation of gall stones, acute jaundice and liver swelling, and later *Westphal* in studying the incidence of gall stone colic, both noticed the significant decrease in the movement of the diaphragm on the right side. *Wilkie* states "The decreased respiratory movement of the right side of the diaphragm in cases of acute biliary inflammations is caused by the abnormal stimulus to the nerve centers on this affected side, and that due to this diaphragmatic weakening, atelectasis and hyperæmia appear, which induce the inflammatory changes in the right lung." We have studied the respiratory movements in patients suffering from biliary affections, both during the time of an attack and in the time when they were free from pain and have compared these with the normal.

The respiratory movement of the diaphragm is not easily measured by the X ray because it depends on various factors difficult to control. We followed the method described by *Schuhlmeyer*, the displacement of the peak of the diaphragm by deep respirations. The results are embodied in Table I.

TABLE I

Sex	No. of cases	Age	Excursion of the base of the diaphragm	
			Right side cm	Left side cm
Male	22	20-39	2 5-6 0	2 0-6 0
Female	22	17-41	2 0-5 0	1 2-4 5

Therefore, in healthy men the average is 3.97 centimeters on the right side and 3.94

centimeters on the left side, and in healthy women the average is 3.54 centimeters on the right and 3.34 centimeters on the left

TABLE II

Sex	No of cases	Diagnosis	Excursion of the halves of the diaphragm	
			Right side cm.	Left side cm.
Male	8	Cholecystitis Cholelithiasis Common duct occlusion	0.3-4.0	1.8-3.0
Female	7	Cholecystitis Cholelithiasis	1.2-3.0	2.2-3.5
Average Male			1.42	2.01
Average Female			2.16	2.68

In Table II are recorded similar determinations upon patients with biliary affections, but during the periods when they were free from attacks. The average excursion in the men was 1.47 centimeters and in the women 2.16 centimeters.

TABLE III

Sex	No of cases	Diagnosis	Excursion of the halves of the diaphragm	
			Right side cm.	Left side cm.
Male	3	Cholecystitis Cholelithiasis	0.2-1.0	0.9-2.5
Female	2	Cholecystitis Cholelithiasis	0.5-1.5	2.0-2.3
Average Male			0.51	1.46
Average Female			1.0	2.15

In Table III are similar determinations in patients during an attack. The average excursion in man is 0.5 centimeter and in women is 1 centimeter.

From the tables we can see therefore how great is the difference between the normal and the diseased especially in an acute attack. Westphal and Wilkie explain this difference by the fact that during an attack of colic the nerves of the right side of the diaphragm are abnormally stimulated. Our conclusions however, did not agree with this, since this difference is present, not only during

an attack of colic, but also when the patient is free from an attack, as shown in Table II. From our observations, we believe that the decrease in excursion of the diaphragm is due mainly to adhesions, especially during the periods of freedom from pain, and the more extensive is this scarring at the site of disease, the more significant is this change.

## CONCLUSIONS

1 From the present observations it is noteworthy how often one meets with pneumonia and bronchitis which is brought about by biliary inflammation.

2 It can no longer be said that the cause of the disease lies in the chest when the pneumonia is associated with jaundice or other evidence of biliary inflammation.

3 When the cause of the pneumonia and bronchitis is not clear, it is important to consider these obscure bile duct affections which may be responsible. Likewise, through the chest findings one may discover bile duct disease which was hard to recognize.

4 Study of the movement of the right side of the diaphragm in these cases is of diagnostic importance and also gives an idea of the degree of cicatrization, because this respiratory movement depends upon the amount of scarring or adhesions.

5 General anesthesia might be contra-indicated in cases of this type and one will obtain better results by operating under a local anesthetic whereby the chest complications are not aggravated.

## EXPERIMENTAL STUDIES OF LUNG AND BRONCHIAL INFLAMMATIONS SECONDARY TO BILE DUCT AND GALL BLADDER INFLAMMATIONS

The purpose of this second part of our contribution is to answer the questions as to how the pneumonia is caused in individuals who have biliary infections. In 1903, Kayser and Brion performed experiments in which they injected pneumococci into the gall bladder of a dog for the purpose of producing this complication but they reported no positive results. On account of these negative results, and despite the efforts of other investigators such as Bahrdt, Kehr, and Wilkie, this question has been neglected. We have tried to



END-RESULTS OF TRANSPLANTATION OF THE URETER<sup>1</sup>

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A REVIEW of the literature shows that the results of implantation of the ureter are successful in the hands of comparatively few surgeons. The technique of this operation has been well described by Charles Mayo, Coffey, Lower, Franklin Martin, Styles, Fowler, Peters, and others, while the pathology, bacteriology, and kidney functions have received little attention.

Much credit is due Franklin Martin for work done as early as 1898. Martin implanted the ureter in the rectum in 37 dogs and 3 human beings. Of the dogs, 4 lived for an indefinite period, 2 having both ureters implanted in the rectum. Of the humans, 1 patient, in whom the ureter was implanted following removal of the bladder, lived 3 years. In a second, the operation was performed for exstrophy of the bladder and was only a partial success. One dog with a double implantation later died of an intercurrent infection and an autopsy examination was made by F. R. Zeit. The right kidney showed a suppurative nephritis. The left kidney was almost normal except that one portion had a nodular appearance similar to the granular kidney of chronic interstitial nephritis. The capsule was slightly adherent over this portion. The bladder was moderately distended with a semipurulent fluid which escaped from the urethra when pressure was exerted. Had Martin used rubber tubes or ureteral catheters in his operation it would have revolutionized this work at an earlier date. We believe the rectum is not as satisfactory a field for implantation as is the large bowel higher up.

The work of Martin was followed by that of Peters, who made an excellent contribution in 1901 on results obtained with a technique very similar to that of Martin.

Inasmuch as the consensus among surgeons favors the nonoperative treatment for bladder cancer, I am of the opinion that ureteral implantation is destined to become more popular in early cancer cases in the future than it has been in the past.

I agree with Coffey that this operation should not be used in the late cancer stage because metastasis, hydro ureter, and poor kidney function are likely to follow.

While this is only a preliminary report I believe that before the operation is more extensively used there should be greater familiarity with the functional, bacteriological and pathological results of the operation. If the surgeons doing the operation would devote less time to reporting the technical details which are sufficiently well known, and devote more time to extending our knowledge by their observations regarding functional, bacteriological, and pathological details, I think the value of ureteral implantation would be greatly enhanced. Therefore it seemed desirable to try to learn from experiments what the results are as to kidney function, pathology, and bacteriology following ureteral implantation. For this purpose we have operated on 14 dogs and 1 human being, using the Coffey technique.

The work of ureteral implantation was started in October, 1925. Of the first 5 dogs operated on 4 died. At autopsy the same pathological condition was found in each dog. Death was not due to the Coffey technique but to our failure to draw the ureter far enough into the lumen of the bowel and to the fact that there was too much tension on the ureter the result being a suppuration at the site of implantation into the bowel and, hence, an ascending infection into the kidney producing an acute pyelitis and general peritonitis. Perfecting the technique by taking away all tension from the ureter after implantation and introducing the ureter far enough into the bowel we secured better results and we found that the urine emptied freely into the lumen of the bowel. In these experiments the dogs made a good recovery from the operation and were allowed to go on to complete convalescence. Later they were studied for function and bacteriology, and finally, pathology.

<sup>1</sup>Read before the American College of Surgeons, Boston, Massachusetts, October, 1928.

We are reporting only the results of single implantations for the reason that in these dogs the normal side was used for a control. My only regret is that we have not more dogs to report at this time. At the present time we have 5 dogs living. Our observations on the results of implantation in these dogs will be reported at a later period.

*Dog 1* Small, yellow, young male dog was given ether anesthesia on November 10, 1925 and the following operation performed. A low right rectus incision was made, the rectus muscle being displaced medially. The ureter was raised with forceps and stripped of its peritoneal covering for a distance of about 3 inches. A small incision was then made into the lumen of the ureter and a probe passed both proximally and distally. The ureter was then dropped back into position, no attempt being made to close the opening in the ureter or to peritonize it. The reason for so doing was to determine whether a wound in a ureter will close spontaneously or if peritonitis will develop from leakage of urine. The peritoneum was closed with No. 1 catgut, the muscles with continuous chromic catgut, the fascia with No. 1 catgut, and the skin with interrupted sutures. Collodion dressing was applied.

On November 21, 1925, 11 days after the operation, the dog was apparently in good condition. On December 2, 1926, the dog died. The autopsy findings were as follows:

Marked confluent suppurative bronchopneumonia and bilateral sanguino-purulent pleuritis. The peritoneal cavity, especially the pelvis, was discolored being dark gray to black. There was no fluid present. There were no adhesions. The retroperitoneal fat was necrotic. A soft fluctuating tumor mass about the size of an almond was found adjacent to the left wall of the bladder. The right kidney was larger than the left and its upper pole was streaked with grayish yellow streaks radiating outward from the medulla. At the periphery these streaks looked like depressed spots beneath the capsule. No fluid or pus could be expressed from these areas. There was no evidence of infection of the pelvis or ureter but there was a patch of submucous ecchymosis in the bladder above the opening of the right ureter. The bladder was contracted but its walls were otherwise normal. Attached to the left wall of the bladder was an oval, fluctuant mass about 2.75 centimeters long by 1.5 centimeters in diameter. This was a smooth-walled cyst filled with a partly clotted hemorrhagic fluid. The lining of the cyst was roughened at its point of attachment to the bladder but there was no communication between the two. The opening in the ureter was patent and opened into retroperitoneal tissue. As nearly as one could tell, the peritoneum covering it was intact.

Microscopic examination of kidney tissue revealed a slight ascending urinary infection with cloudy

swelling of the left kidney. The right kidney showed a marked ascending urinary infection with many small cortical abscesses.

*Dog 2* Large, brown male dog, anesthetized with ether and operated upon November 17, 1925. Low right rectus incision made. Right ureter was isolated and freed from peritoneum over a distance of about 5 inches. The ureter was ligated about 2 inches above its distal extremity and was cut above the ligature. A catheter was then passed into the ureter and held in place by means of a catgut ligature. An incision was made longitudinally in the distal portion of the sigmoid. A rectal tube was passed. The catheter was introduced through the incision in the sigmoid into the rectal tube and drawn out through the anus. The rectal tube was then withdrawn. The serosa and muscularis were sutured over the ureter at the point of incision in the sigmoid. At this point the dog died from ether asphyxia.

*Dog 3* Large, brown male Airedale was given an ether anesthetic on November 20, 1925, and a lower left rectus incision was made. The left ureter was isolated and implanted into the sigmoid, the technique described under Dog 2 being used. This dog died November 24, 1925, and autopsy revealed a huge phlegmonous gangrene of the abdominal wall about the incision. There were many abscesses about the incision in the sigmoid and loops of small bowel were also markedly adherent in this neighborhood. There was much free pus in the peritoneal cavity. The ureter came away easily. The catheter was not found in the rectum.

Diagnosis: leakage about ureteral implant and generalized peritonitis.

*Dog 4* Large white male with grayish black spots was given ether anesthesia and operated upon November 24, 1925. The technique used in this operation was the same as that used in Dog 2, except that both ureters were implanted into the sigmoid, one on the right side and one on the left side of the bowel, the ureter implanted on the right side being placed at a slightly lower level than the one on the left. During the operation it was noticed that the flow of urine from the left ureter was less free than it was from the right. This was probably due to the ligature about the left ureter being tied too tightly.

This dog died November 27, 1925. Autopsy revealed a general peritonitis and necrosis of the ureters about their point of entrance into the bowel.

*Dog 5* Large long-haired, brown and white male was operated upon November 27, 1925. The same technique was used in this operation as in those previously described, only the right ureter was implanted. On November 30, 1925, the dog was apparently in good condition. It continued to progress and finally made a complete recovery, so that on November 4, 1926, the dog was apparently well and running at large in the big pen.

On December 10, 1926, the dog was again anesthetized, the left ureter isolated and implanted into the sigmoid as previously described. The dog died on December 20, 1926. Autopsy showed the incision

gaping and sloughing with much purulent discharge. Peritoneum was adherent to the right side of the bladder and sigmoid. Pelvic peritoneum was injected and dulled with fibrin.

The right kidney was about half the size of the left which was about normal. There was fibrous perinephritis at both poles of the kidney. Both poles were quite markedly scarred and pitted. The cortex was thin and markings were destroyed. The pelvis and proximal portion of ureter were dilated and thickened, the mucosa was injected and roughened. The ureter was anastomosed to the sigmoid 10 centimeters above the anus. There were a few omental adhesions about the anastomosis. The peritoneum was continuous from the ureter onto the bowel. The ureter passed between serosa and mucosa for 22 millimeters and then opened through an opening which admitted a fine probe. The mucosa about the opening was smooth and there were no ulcers or tons.

The left kidney was of normal size. The pelvis and entire ureter were dilated. Mucosa studded with petechial hemorrhages. Ureter entered sigmoid 7.5 centimeters from anus. This ureter passed below mucosa for about 2 centimeters. Over it the mucosa was smooth. There was a distinct obstruction about the middle of the submucous portion and only a very small probe could be passed.

Anatomic diagnosis: chronic right hydronephrosis, ascending urinary infection with atrophy and scarring, acute left ureteral obstruction.

**Dog 6** Medium sized white short haired male, operated upon December 7, 1915. The left ureter was isolated and implanted into the sigmoid by the same technique as previously described. In this operation the sigmoid was fastened to the lateral pelvic wall by one catgut stitch.

On January 4, 1916 the dog was in good condition and continued to progress throughout the next year. On February 7, 1917, 1 year and 2 months after the first operation, the dog was again anesthetized and a midline incision made. The left ureter was isolated then incised, and a ureteral catheter inserted. There were a few adhesions about the site of anastomosis but these were not marked. The right ureter was also isolated, incised, and a catheter inserted. A kidney function test was done, 1 cubic centimeter of phenolsulphonephthalein being used with the following results: From the right kidney dye appeared in 3 minutes in good concentration. From the left kidney dye appeared in 3½ minutes in good concentration. The dye showed 25 per cent on each side in 15 minutes.

The dog was killed with ether. Autopsy showed the right kidney entirely normal. The left kidney was smaller than the right and was scarred at both poles. The capsule was scarred and thickened at poles. The pelvis and ureter were of normal size. The anastomosis was well healed with some thickening of the left ureteral wall in the distal third. The opening of distal portion of the left ureter into the bladder was not found.

**Dog 7** Small brown male operated upon December 15, 1915. Operation consisted in anastomosing the left ureter to the sigmoid. The technique previously described being used. This dog made a complete recovery and 2 years later (February 1, 1917) was again anesthetized. The ureters isolated, incised and catheterized. Urine was collected for culture. Functional test showed the appearance of the dye within 3 minutes from each kidney. The dye was in good concentration. In 15 minutes the dye showed 22 per cent on the left side and 21 per cent on the right side.

The dog was killed with ether. Autopsy revealed the anastomosis well healed and the left kidney of normal size. There was very slight scarring of the capsule. The right kidney was enlarged, the ureter thickened and marked hydronephrosis was present. No scars were present. The ureter was patent and a probe could be passed from the ureter into the bladder.

There is no explanation for the hydronephrosis on the unanastomosed side unless pelvic infection secondary to operation caused a peritonitis.

**Dogs 8, 9, and 10** were operated upon December 9, 11, and 13 respectively, 1915. The Coffey technique as previously described being used.

On February 8, 1917, 1 year and 2 months after operation, these dogs were anesthetized in the same manner as were Dogs 5, 6 and 7. The right ureter which had been implanted in the previous operation was isolated and a double ureteral catheterization was done by making a small slit in each ureter. A kidney function test was done, 1 cubic centimeter of phenolsulphonephthalein being used with the following results:

In Dog 8 the dye appeared on the good side in 3½ minutes and on the right or implanted side in 4 minutes. The function on the left side was 22 per cent in 15 minutes while on the right it was 18 per cent. Bacteriology was negative on both sides.

In Dog 9 the dye appeared on the left side in 3½ minutes and on the right or implanted side in 4½ minutes. Function was equal on both sides—21 per cent in 15 minutes. The urine was negative on both sides.

In Dog 10 the right ureter was found to be slightly larger than the left. The right was the implanted side. In the dye test the dye appeared on the left side in 3½ minutes and on the right side in 6 minutes. Laboratory analysis showed colon bacillus in the urine from the implanted side and sterile urine on the left side. The pathology will be shown in the accompanying slides.

In this case the implant was made into the bladder instead of into the bowel. Hydro-ureter and hydronephrosis were marked especially the hydro-ureter. This was due to a constriction of the ureter at the place where the implantation into the bladder was made. We tried to use the technique as in the bowel but apparently the bladder does not work with the same valve like mechanism. In other cases in which we made an implantation into the bladder we found



Fig 1 Bowel ready before double transplant



Fig 2 Introduction of ureter in single transplant

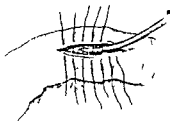


Fig 3 Method of suturing after introduction of ureter

we were apt to get a hydro ureter, which proves pretty conclusively that the Coffey technique of transplantation in the bowel is the operation of choice

The advisability of implanting the ureter into the bladder with a resultant hydro ureter is very well shown in the operation on the human. In this patient the ureter had been severed and it had anastomosed to the cutoff cervix following a hysterectomy, at the point of anastomosis the ureter due to constriction was about the size of a large cambric needle

The remaining portion of the ureter was a true hydro ureter. This demonstrates clearly that the technique used in the bowel implant is the correct one

The patient on whom this operation was performed presented the following history

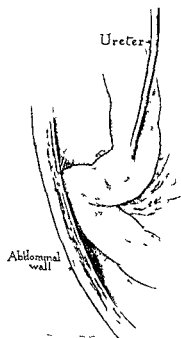


Fig 4 Suture holding bowel in place to relieve tension on ureter

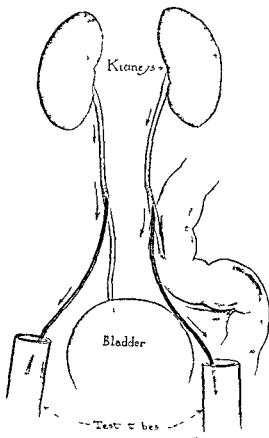


Fig 5 Technique of doing function test and collecting urine



Fig 6 Operation completed

Mrs H aged 41 years entered the hospital on December 27 1926 complaining of incontinence of urine and dribbling. She had been operated on 6 months previously for fibroid of the uterus. Twelve days after operation she noticed the incontinence and loss of bladder control.

Physical examination was essentially negative except for the bladder condition. Further examina-

tion showed that part of the urine was coming from the vagina while the rest came through the natural channel.

Cystoscopic examination was made. The right ureter was catheterized without difficulty. On the left side the catheter met an obstruction about 6 centimeters above the ureteral orifice. A normal flow of urine was obtained from the right side but no urine from the left. Indigocarmine was injected intravenously. The blue color could be seen coming very rapidly from the right side but nothing came from the left side. By means of a vaginal speculum the blue urine could be seen coming from the cervix. The patient was kept under observation for 4 days and no further information elicited. It was evident that she had a fistula of the left ureter but it was impossible to tell how high up in the ureter it was located.

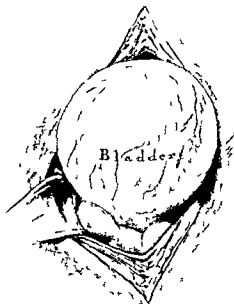


Fig 7 Relative size of dog bladder

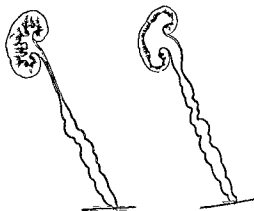


Fig 8 left Hydro-ureter with a direct implant  
Fig 9 A hydro-ureter and hydronephrosis with a direct implant. Much care should be observed in following the Coffey technique so as to avoid the above condition.



Fig. 10. Medium power section from parenchyma about 2½ centimeters from kidney pelvis

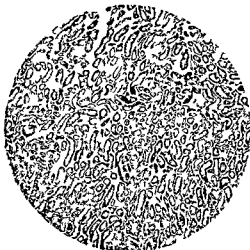


Fig. 11. Low power section in same position as in Figure 10



Fig. 12. Medium power. Transverse section of the tubule showing little pathologic



Fig. 13. Low power. Clomerali and tubules in apparently perfect condition

She was taken to the operating room on January 1, 1927 and injected with indigocarmine after which an incision was made over the left rectus muscle so that it was possible to enter the perivesical space. This was done in the hope that we could find the opening of the ureter. After thorough exploration it was decided to open the peritoneal cavity. Both anterior and posterior incisions were made and the end of the ureter was picked up after some delay as adhesions were present from the previous operation. It was found that the end of the ureter had been tied off and had opened into the cervix. The ureter was somewhat dilated throughout due to a stricture at its distal end. A ureteral catheter was introduced

into the ureter and another opening was made into the peritoneum near the bladder. A small opening was made in the posterior wall of the bladder the distal end of the catheter was introduced into the bladder and the ureter was implanted in a manner similar to that described in the experimental work. The bladder was then closed. Drains were inserted into the peritoneal cavity and into the perivesical space. A retention catheter was inserted in the bladder and the urine drained through the natural channel.

The patient made an uneventful recovery. On the eighth day the distal end of the catheter was withdrawn from the bladder through the urethra by



Fig. 14 Section from the gross specimen which apparently showed pathology. On microscopic examination very little pathology was evident.

means of a rongeur. The urine appeared perfectly normal this was confirmed by laboratory analysis. On February 2 the patient was discharged from the hospital as cured. Before discharge a functional test was made. Seventeen per cent of dye was obtained in 15 minutes from the side operated upon. The patient at the present writing (October 1928) appears to be in perfect health.

# CONCLUSIONS

1 In my opinion the Coffey technique is the method of choice.

2 A more extensive study with regard to kidney function, bacteriology, and pathology, should be urged.

3 In the treatment of bladder cancer, implantation of the ureter into the large bowel should be practiced.

4 This operation is the one of choice for evstrophy of the bladder.

5 It is more important to guard against the development of a hydronephrosis than to avoid ascending infection. I believe that the danger of hydronephrosis will be eliminated by a change in the technique with reference to the muscularis and mucosa of the bowel. Recently we have invaginated in dogs the muscle at the site of the implantation to permit healing to take place without impingement of the muscle of the bowel upon the ureter. We have also made the incision in the mucosa larger and have inserted one suture at site of introduction of ureter into bowel lumen to prevent pinching of ureter by mucosa.

I wish to express my appreciation to Dr. Willard Van Hazel and Dr. Chester Guy, who with their co-operation made this article possible.

# CLINICAL SURGERY

FROM THE CLINIC OF LORD MOYALIAN

## CHOLECYSTECTOMY

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ALTHOUGH a large number of cases of gall stones are found postmortem in cases dying from other conditions it is probably never true to say that they have been symptomless though they may have been unsuspected, during life. A careful inquiry would almost certainly have elicited a history of an ordinary indigestion which had been neglected and we know that no indigestion is ordinary. As a rule it is only when a stone slips down to become impacted in a duct and to cause colic that a patient looks back and recalls the irregular flatulent dyspepsia which is so typical of the early stages of gall bladder disease. In the absence of this accident the evidence of gall stones would probably pass unrecognized. We have a further method of recognizing gall bladder disease and that is by means of cholecystography, which during a routine examination may reveal the presence of gall stones or of their precursor a cholecystitis. This has been made possible by the work of Graham who has shown that the absence of a shadow of the gall bladder after administration of the dye is due to disease.

Much has been made of the medical treatment of gall stones but at the best this can do no more than keep the sufferer comfortable. An infected gall bladder left *in situ* is a menace to the general health and may ultimately give rise to a fatal complication. Infection may be absorbed and lead to chronic joint disease and years of unnecessary ill health and suffering. It may be the focus of infection which acts on the stomach or duodenum with the production of ulceration or it may infect the pancreas thus causing that rare but fatal complication of acute pancreatitis. Finally carcinoma of the gall bladder never occurs in the absence of the irritation due to gall stones.

Medicine has a further charge to answer and that is of being responsible for a large part of the mortality of cholecystectomy small as it is.

Death occurs in those cases in which the liver has been damaged by a continuous reabsorption of toxins or by back pressure from a stone which has been impacted in the common bile duct for a considerable time. As in an acute abdominal emergency, the mortality is the mortality of delay.

### COMPLICATIONS

Probably nowhere in surgery is an exact knowledge of the normal and abnormal anatomy more necessary than in operations performed on the gall bladder. The variations are few and must be recognized a failure to do so may be fatal to the patient or the repair of the mistake which has been made may tax the ingenuity of the most experienced and dextrous of operators. These variations have been studied by Flint and recorded in the *British Journal of Surgery*, 1923, v. 509.

The right hepatic artery may pass in front of the common hepatic duct in one case in eight. One case in six, we find has an accessory cystic artery which usually rises from the right hepatic artery.

The cystic duct is usually bound down to the common hepatic duct for some distance and it is possible to separate them down to the point at which they join to form the common bile duct, which is usually 1 centimeter above the upper margin of the duodenum. Accessory bile ducts are present in one case in seven. All of them are accessory right hepatic ducts and they open into the right hepatic duct or the common hepatic duct often as low down as its junction with the cystic duct.

Postoperative hæmorrhage is particularly liable to occur in jaundiced patients, but the danger can be minimized before operation by increasing the coagulation time of the blood by means of calcium chloride and by paying particular attention to hæmostasis at every stage of the operation. A further complication which is seen is an impair-



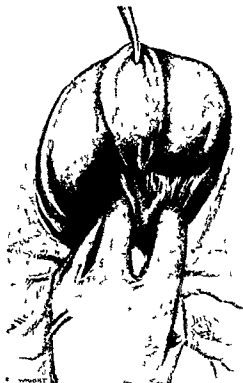


Fig. 1 The left hand of the assistant acting as a retractor

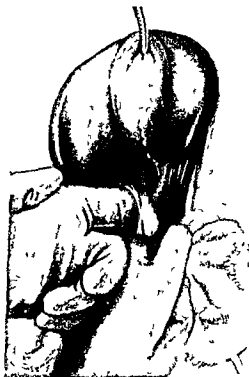


Fig. 2 The surgeon's left index finger in the foramen of Winslow pushing forward a stone in the common duct

ment of the liver function after operation the so called hepatic insufficiency in which the patient usually drains a large amount of thin clear or even white bile and gradually gets weaker and weaker and finally dies

#### PRE OPERATIVE TREATMENT

The patient is kept in hospital for some days before his operation and any focus of infection which may be present particularly in the teeth is dealt with. The best method of protecting the liver from the development of an insufficiency is to insure that at the time of the operation it is plentifully stocked with glycogen. With this end in view glucose is given from the day the patient comes into hospital. He may drink it in a 5 per cent solution with 5 per cent of bicarbonate of soda, or if he finds it unpalatable the taste may be partly disguised by a small amount of orange or other fruit juice. A jug containing this mixture is left at the side of the bed and he is told to drink as much of it as he can manage. The same solution is also given by the rectum with the addition of 5 minims of tincture of opium to a pint

of solution if as not infrequently happens it irritates the bowel.

The coagulation time of the blood is estimated, and in those cases in which it is long and in every case in which there is jaundice calcium chloride is given. Three doses of 5 cubic centimeters of a 10 per cent solution are given intravenously at 12 hour intervals immediately before the operation. The operation area is prepared from the nipples to the upper part of the thighs. It is shaved and the night before the operation it is cleaned with ether soap followed by a 1:2000 solution of biniodide of mercury in rectified spirit. It is then dried and painted over with a 3 per cent solution of picric acid in spirit and covered with a sterile towel which is bandaged on and is left in position until after the patient has been anesthetized.

#### THE ANÆSTHETIC

A preliminary injection of  $\frac{1}{4}$  grain morphine  $\frac{1}{100}$  grain scopolamine and if the patient has any bronchitis,  $\frac{1}{100}$  grain atropine is given half an hour before he leaves the ward. Anesthesia is induced by gas and oxygen given through a

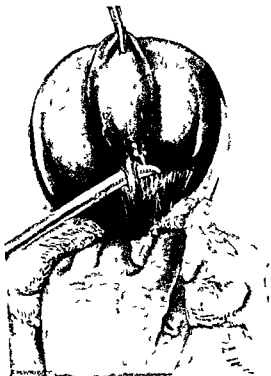


Fig. 3 To show the method of passing a tube around the cystic duct

Boyle's apparatus and it may be reinforced by a small amount of ether when the abdomen is being opened and closed and when the common bile duct is being manipulated. Chloroform has a direct toxic action on the liver cells which have already been subject to a varying amount of stress and should never under any circumstances whatever be employed.

#### THE OPERATION

The patient lies on the operating table with a support under the lower ribs. This pushes the upper part of the abdomen forward and renders the gall bladder and its ducts more accessible. As this is an uncomfortable position for the patient to assume when he is conscious, he therefore lies flat on the table with a deflated rubber bag in the required position until anesthesia has been induced when the bag is filled with air. Some operating tables are fitted with a small platform which can be raised at the necessary site and if they are used the rubber bag is not called for.

The operation area is exposed and is cleaned as in the preliminary preparation except that

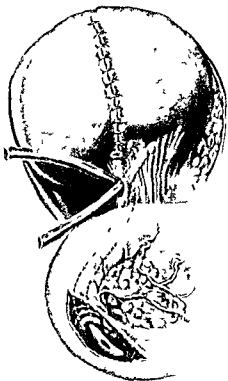


Fig. 4 Gall bladder removed tubes in position

Harrington's solution is substituted for the picric acid. The sheets are next fixed in position—they are green, a color which has been found to be restful for the eyes of the surgeon. The abdomen is opened by means of a right paramedian incision extending from the costal margin to below the umbilicus, displacing the rectus muscle outward. This incision gives a good approach to the gall bladder and has the great advantage that it leaves a perfect scar afterward. It is therefore employed in every case except in the extremely fat patient in whom a subcostal incision gives better access. Every bleeding point is seized by means of artery forceps and is ligated before the intra-abdominal part of the operation is proceeded with. It is important that the wound should be absolutely dry, as bleeding is very likely to go on and lead to bruising or in the more persistent cases to the formation of a hematoma. The skin edges are protected by tetra cloths and the peritoneum is opened.

The stomach and duodenum are inspected carefully and then the rest of the abdomen is rapidly reviewed by palpation. In the absence of any further disease the caecum is pulled up into the lower angle of the wound and the appendix is removed. Attention is now paid to the gall bladder which is inspected and then palpated for stones. Finally, the left index finger is inserted into the foramen of Winslow and the common bile duct is carefully rolled between it and the thumb. When the hand is moved up and down it is possible to examine the whole length of the duct, even down to the ampulla of Vater.

It is never necessary to open the duct in order to see whether it contains a stone, careful palpation and familiarity with the region are all that is necessary, and even the smallest of stones can be thus detected. If a stone is found it is to be removed before the gall bladder is dealt with as a little gentle traction on the gall bladder will make the common duct very much more accessible.

The rest of the abdomen is packed off with mackintosh swabs and the left hand of the assistant placed on top of them acts as a retractor and prevents the intestines from pressing up into the operation area. Everything depends on the way this retraction is done, and a well trained assistant can make easy what would otherwise be a very difficult operation.

A slight rotation of the liver around its transverse axis is possible and makes the ducts more accessible. The free edge of the liver is pulled downward and then forward and upward out of the wound. It is held in this position by forceps applied to the gall bladder and is kept warm and moist with a mackintosh swab.

The gall bladder close to the opening of the cystic duct is seized by a Parker's clamp and drawn upward as much as possible. The stone or one of the stones lying in the common duct is manipulated until it lies between the upper border of the duodenum and the cystic duct, and in this situation it can be made prominent by a finger in the foramen of Winslow and can be cut down onto with perfect safety. Stones are evacuated through this incision until the duct is clear and a malleable probe is passed downward through the ampulla of Vater into the duodenum. In cases in which there is a thick sediment lying in the duct it may be cleaned out by a wisp of gauze, which can be pushed up into the hepatic ducts if necessary.

Finally a thick walled tube is passed upward to drain off the bile and a catheter is passed downward until its end can be felt in the duo-

denum, and the wound in the duct is partially closed by stitches until it fits closely around these two. The tubes themselves are fixed to the sides of the opening by a stitch as they would otherwise tend to be expelled too early. This catheter in the duodenum is of the greatest value as it provides a means by which fluids and particularly glucose can be administered from the moment the patient is back in bed if necessary.

Attention is now turned to the gall bladder and its ducts are identified. It cannot be too strongly insisted on that nothing is to be done until the cystic duct, the common bile duct and the common hepatic duct are recognized. To do this the peritoneum covering the front of the cystic duct is divided with scissors and together with the underlying fat is stripped off the ducts by gently wiping them with a gauze swab. Only one snip with the scissors is necessary, after that everything is done with the gauze held in a long pair of dissecting forceps. Sometimes this step may take a little time but, even in the most adherent cases the anatomical relations can be displayed clearly. When this has been done the tip of a pair of curved cholecystectomy forceps is thrust from the right side through the triangle bounded by the cystic duct, the common hepatic duct, and the cystic artery. If the blades of the forceps are now opened they will free the cystic duct for a small distance and separate it from the common duct in those cases in which the two are bound up together. A piece of stout catgut is seized by the forceps which when they are withdrawn, thread it behind the cystic duct, and the cystic duct is tied. If this ligature is too close to the common duct, it may be the cause of the development of a fibrous stricture in that duct and therefore it should be applied at a point 2 millimeters from the junction. The ends of this ligature are brought out of the wound and left long. The cystic duct is clipped above the ligature by a pair of cholecystectomy forceps and divided with scissors between the two. The cut ends are sterilized by being touched with pure carbolic acid. A little further gauze wiping will render the cystic artery obvious and a ligature is passed round it by the method which was used for the cystic duct and it is divided. It is not uncommon to find an accessory cystic artery a little farther back which will also need to be ligated before the gall bladder can be removed. The gall bladder is stripped forward from its bed. This can be done quite well with the finger, a pair of scissors being used to divide the peritoneum on each side as the separation goes on. Finally in the cases in which there has not been a recent acute attack the

peritoneum is drawn across the gall bladder fossa by means of three or four stitches

Sometimes there is a little oozing of blood from the raw surface of the liver but this usually stops if a hot saline swab is left in contact with it for a few minutes. Rarely when the hemorrhage is more persistent, a pack may be left in and removed at the end of 48 hours. A drainage tube should always be left down to the operation area, or rather to the right kidney pouch, and this tube is held in position by having the ligature from the cystic duct which was purposely left long, tied loosely around it. Finally, an omental veil is made by stitching the falciform ligament to a piece of the right side of the great omentum and this veil is gently pushed up so as to separate the first part of the duodenum from the gall bladder fossa.

The support is removed from under the patient's ribs and he is brought down flat before the abdominal incision is closed. The peritoneum is closed by means of a continuous suture, after which the tetra cloths are removed and the skin is swabbed over with the biniodide of mercury in spirit solution. Deep silkworm gut stitches which include the rectus sheath are inserted but not tied, the rectus sheath is closed with interrupted catgut stitches and the skin edges are approximated with Michels' clips. The silkworm gut stitches are threaded through a piece of fine rubber tubing before they are tied and a dressing is applied.

The patient is taken back to the ward and as soon as he has recovered from the anæsthetic he is propped up in Fowler's position. In cases in which a tube has been put through into the

duodenum, glucose is administered through it by means of a continuous drip, or in the cases in which the common duct has not been opened it is given by the rectum.

The thick walled tube, which is draining the common hepatic duct is connected up by an extension to a bottle at the side of the bed into which the bile drains for some days. The stitch which keeps it in position usually holds for about 14 days when it and the duodenal catheter begin to work their way out. As soon as these tubes are out, some bile begins to find its way down the common duct, the faeces become colored, and in 2 or 3 days the wound dries up. The tube which was put down to the right kidney pouch should be removed after 48 hours. It usually comes out quite easily, but in very nervous patients or in those in whom a gauze pack has been left a whiff of gas may be given with advantage. This pack comes out much more readily if a little hydrogen peroxide is poured onto it two or three times before it is taken out.

Patients usually complain of a good deal of flatulence for 2 or 3 days after the operation, but if a rectal tube is used, enemata are given and if necessary, small doses of eserine, they can usually be kept comfortable. This condition usually becomes a good deal easier after 48 hours, when the big tube is taken out which would appear to suggest that its presence may have some inhibitory effect from direct contact, on the movements of the large intestine.

Patients are allowed to get out of bed at the end of a fortnight or when the tubes have all come out, and they are able to leave the hospital 3 weeks after the operation.

## FROM THE SURGICAL CLINIC OF GU1S HOSPITAL

## CHOLEDOCHOTOMY

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**I**NCISION and exploration of the common bile duct is often required to find out and if possible to remove the cause of recurrent biliary colic or obstructive jaundice. The association of these two symptoms is nearly always due to gall stones obstructing the common bile duct but occasionally severe pain if not typical colic, accompanies jaundice due to malignant disease obstructing the common bile or common hepatic duct. When the latter is obstructed the gall bladder is not enlarged, thus making the mimicry of gall stones all the more puzzling. It is well known as Courvoisier pointed out many years ago that jaundice without enlargement of the gall bladder is generally due to calculous obstruction of the common duct, whereas jaundice with enlargement of the gall bladder is usually due to other causes such as malignant disease or chronic inflammation of the head of the pancreas. It is often impossible to ascertain the cause of chronic jaundice without exploring the bile ducts, if the cause prove irremovable cholecystostomy generally prolongs life, relieves the jaundice, and stops the intolerable itching. Occasionally it is necessary to operate for cholelithiasis during intractable jaundice but when ever possible it is safer to wait for an interval between the attacks of colic with jaundice and it is especially desirable to wait for the subsidence of any fever due to cholangitis. It is vitally important to realize that stones may exist in the common bile duct for years without ever causing jaundice and that it is therefore necessary to examine very carefully for stones in the common bile duct during every operation upon these parts. When there is grave doubt it is wise to open the common bile duct and to pass a large pliable probe, both upward into the hepatic ducts and downward through the papilla into the duodenum.

## DIFFICULTIES, DANGERS AND POSSIBLE COMPLICATIONS

It is imperative for every surgeon who undertakes operations upon these intricate parts to know the many pitfalls that await him (Fig. 1). There are many variations in the anatomy of the

bile ducts and of the arteries and veins in close relation to them, moreover pathological changes, such as congestion inflammation oedema fibrosis contractions and adhesions, and perhaps malignant disease so alter the appearance and feel of the parts that adequate exposure great caution and endless patience and discretion are necessary to enable the surgeon to identify and display the ducts adequately before the common duct is opened. Failure to observe these precautions may lead to intractable hemorrhage or serious and perhaps irreparable injury to the bile ducts or duodenum. The ducts need very careful exploration with the finger or probe, otherwise one or more stones may be left behind. Inflammatory thickening around a small stone impacted in the second or third part of the duct is especially liable to be mistaken for carcinoma and the stone may be overlooked unless the duct is opened and explored. Sometimes it is necessary to open the duodenum to ascertain the nature of a swelling at the duodenal papilla.

## PREPARATION OF THE PATIENT

The need of this operation is rarely, if ever urgent therefore it always pays to prepare the patient with care and deliberation. He is kept at rest for at least 2 days before the operation. An aperient is given not later than 24 hours followed if necessary by an enema 8 hours before the operation. The mouth and teeth are frequently and adequately cleansed and the operation is deferred if necessary until all signs of oral or nasal sepsis have been eliminated. It is particularly important to wait if there are any indications of an oncoming catarrh of the nose throat or respiratory organs on account of the danger of pneumonia supervening. If blood clotting is delayed from long continued jaundice I inject intravenously 5 cubic centimeters of a 10 per cent sterile solution of calcium chloride once a day for 2 or 3 days before the operation and to meet any depreciation of the liver function I give glucose solutions freely by mouth rectum or intravenously. The day before the operation the skin of the abdomen is shaved if necessary and a warm bath given. On the morning of the operation the skin of the abdomen is painted with tincture of

iodine, and this is repeated when the patient is under the anæsthetic

#### OPERATION

The deeply placed common bile duct is made more accessible by means of a soft rubber air cushion placed behind the lower part of the chest or by the raising of the bridge situated here. This opens out the costal angle brings the bile duct well forward and makes the intestines fall out of the way toward the pelvis. The head and thighs are also flexed to relax the abdominal wall. A paramedian incision half an inch to the right of the middle line extending from the right epigastric angle to the level of the umbilicus gives excellent exposure of the common bile duct and is therefore the most useful for dealing with disease limited to the duct. Moreover very little bleeding occurs from this incision, an important point when jaundice is present. This approach is especially selected in recurrent cases when other incisions have been made farther out in the usual situations for troublesome adhesions may thus be avoided. If the gall bladder needs removal and more room is required the rectus can be cut across at the lower end of the incision after the method of Perthes. Every bleeding point is immediately tied with fine catgut before the peritoneum is opened. The abdomen is rapidly but carefully explored so that no disease or complication may be overlooked then the biliary apparatus is carefully inspected and palpated to ascertain the cause of the symptoms and the exact plan of action is now decided upon. The duct may be opened above behind or through the duodenum but the first of these is usually the method of choice.

*Supraduodenal choledochotomy.* Any omental and other adhesions are carefully separated by gauze dissection care being taken to avoid lacerating any of the adherent viscera especially the first part of the duodenum every bleeding point is tied at once. The edges of the parietal wound are enfolded with large moist fixed gauze pads and the right kidney pouch is packed with a long dry gauze roll secured at its projecting end. If possible the liver should be pulled downward and forward and then tilted so that its lower surface is well displayed. The assistant with his right hand holds the tilted anterior border of the liver and the gall bladder and with two or more fingers of his left hand hooks and pulls downward and inward the pylorus thus stretching the edge of the gastrophatic omentum and displaying the front margin of the foramen of Winslow while the surgeon closely examines the ducts. Every



Fig 1 Anatomy of the biliary apparatus. Stones are shown in the cystic duct common bile duct and ampulla of Vater. The pancreatic duct of Wirsung and the accessory duct of Santorini are shown the latter opening separately into the duodenum.

gall stone discovered in any part of the common duct is, whenever possible displaced upward into the first part of the duct whence it can be removed with the greatest ease and safety (Fig 2). The left index finger is passed into the foramen of Winslow behind the common bile duct and the whole of the duct is carefully palpated as the thumb is moved down along the front of the duct as far as the duodenal papilla. It is much easier to push the stone backward before the duct is incised and the bile is let out thus allowing the duct to collapse above the stone. Once displaced into the first part of the duct it is raised and firmly held up by the finger behind it. The incision in the peritoneal covering of the duct is cautiously made directly over the stone and well above the duodenum in order to avoid the blood vessels which commonly cross in front of the duct low down near the bowel. Any vessels lying in front of the duct are displaced inward by blunt dissection thus exposing the greenish white dense wall of the duct which, with the bulging stone within protrudes from its peritoneal and fatty sheath. The position, consistence and greenish color serve to distinguish the duct from the portal vein, which has been mistaken for it and opened. Fortunately, the vein invariably lies behind and to the left of the common bile duct so that it is not often seen

## FROM THE SURGICAL CLINIC OF GUY'S HOSPITAL

## CHOLEDOCHOTOMY

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**I**NCISION and exploration of the common bile duct is often required to find out and, if possible, to remove the cause of recurrent biliary colic or obstructive jaundice. The association of these two symptoms is nearly always due to gall stones obstructing the common bile duct but occasionally severe pain if not typical colic accompanies jaundice due to malignant disease obstructing the common bile or common hepatic duct. When the latter is obstructed the gall bladder is not enlarged thus making the mimicry of gall stones all the more puzzling. It is well known as Courvoisier pointed out many years ago that jaundice without enlargement of the gall bladder is generally due to calculous obstruction of the common duct, whereas jaundice with enlargement of the gall bladder is usually due to other causes such as malignant disease or chronic inflammation of the head of the pancreas. It is often impossible to ascertain the cause of chronic jaundice without exploring the bile ducts, if the cause prove irremovable cholecystostomy generally prolongs life relieves the jaundice and stops the intolerable itching. Occasionally it is necessary to operate for cholelithiasis during intractable jaundice but when ever possible it is safer to wait for an interval between the attacks of colic with jaundice, and it is especially desirable to wait for the subsidence of any fever due to cholangitis. It is vitally important to realize that stones may exist in the common bile duct for years without ever causing jaundice and that it is therefore necessary to examine very carefully for stones in the common bile duct during every operation upon these parts. When there is grave doubt it is wise to open the common bile duct and to pass a large pliable probe both upward into the hepatic ducts and downward through the papilla into the duodenum.

## DIFFICULTIES, DANGERS AND POSSIBLE COMPLICATIONS

It is imperative for every surgeon who undertakes operations upon these intricate parts to know the many pitfalls that await him (Fig. 1). There are many variations in the anatomy of the

bile ducts and of the arteries and veins in close relation to them moreover pathological changes such as congestion, inflammation, œdema, fibrosis, contractions and adhesions and perhaps malignant disease, so alter the appearance and feel of the parts that adequate exposure great caution and endless patience and discretion are necessary to enable the surgeon to identify and display the ducts adequately before the common duct is opened. Failure to observe these precautions may lead to intractable hæmorrhage or serious and perhaps irreparable injury to the bile ducts or duodenum. The ducts need very careful exploration with the finger or probe otherwise one or more stones may be left behind. Inflammatory thickening around a small stone impacted in the second or third part of the duct is especially liable to be mistaken for carcinoma and the stone may be overlooked unless the duct is opened and explored. Sometimes it is necessary to open the duodenum to ascertain the nature of a swelling at the duodenal papilla.

## PREPARATION OF THE PATIENT

The need of this operation is rarely, if ever urgent therefore it always pays to prepare the patient with care and deliberation. He is kept at rest for at least 2 days before the operation. An aperient is given not later than 24 hours followed if necessary by an enema 8 hours before the operation. The mouth and teeth are frequently and adequately cleansed and the operation is deferred if necessary until all signs of oral or nasal sepsis have been eliminated. It is particularly important to wait if there are any indications of an oncoming catarrh of the nose, throat or respiratory organs, on account of the danger of pneumonia supervening. If blood clotting is delayed from long continued jaundice inject intravenously 5 cubic centimeters of a 10 per cent sterile solution of calcium chloride once a day for 2 or 3 days before the operation and to meet any depreciation of the liver function I give glucose solutions freely by mouth, rectum or intravenously. The day before the operation the skin of the abdomen is shaved if necessary and a warm bath given. On the morning of the operation the skin of the abdomen is painted with tincture of

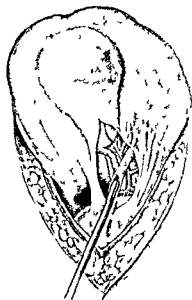


Fig 4 Choleldochotomy The drainage tube has been passed through the opening in the common bile duct upward into the common hepatic duct

At this stage the gall bladder is treated, if necessary as a rule it is removed if it is certain that the common bile duct is patent and if there is no added risk especially from bleeding the result of long continued jaundice or adhesions

**Drainage** The ducts having been cleared it remains to consider the best methods of drainage. When the gall bladder has not been removed, and the cystic duct is patent a tube inserted in the gall bladder and a large tube in the kidney pouch will provide enough drainage (Fig 3). Similarly after cholecystectomy has been added the common duct can be conveniently drained through a dilated cystic duct. Even when indirect drainage through the gall bladder has been established it is rarely advisable to close the incision in the common bile duct and especially if there is septic cholangitis it is better and safer to drain it. Moreover, blood clots or stones overlooked in the hepatic ducts may occasionally obstruct a sutured duct. A long rubber tube  $\frac{1}{4}$  of an inch in diameter is passed into the common duct and upward toward the common hepatic duct and secured in position by means of a fine catgut suture which pierces the tube and the edges of the wound in the peritoneal sheath of the duct (Fig 4). The part of the tube within the duct lies loosely and has one or more side openings in it so that bile may

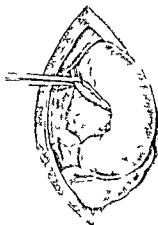


Fig 5 Retroduodenal choleldochotomy The stone is firmly impacted in the second part of the common bile duct behind the duodenum which has been mobilized and turned over to the left The duct was embedded in the head of the pancreas

still pass down the common bile duct. One or more catgut sutures may be inserted if necessary to close the opening in the duct snugly round the tube. To prevent contamination of the peritoneum and parietes a rubber tube  $\frac{1}{2}$  an inch in diameter is always passed into the kidney pouch below and outside the wound in the common bile duct. In some cases especially when a vertical parietal incision has been used drainage may be established through a stab wound in the right flank, so that the median wound can be completely closed and hernia thus avoided. If the Kocher incision has been used the drainage tube will lie in the lower and outer angle of the wound. The bile is conducted into a baby's feeding bottle by the side of the patient, secured in proper position by tapes. In all cases it is wise to sew the tubes separately to the skin so that they may not be accidentally withdrawn. The fine tube will become detached from the duct in about a week and should then be removed. The larger tube draining the kidney pouch may be safely and easily withdrawn after 2 or 3 days. Gauze wicks, plugs or packs are unnecessary and harmful; their removal causes needless pain, delay in healing and sometimes hæmorrhage.

**Retroduodenal choleldochotomy** If possible the stone should be passed upward into the first part of the duct or drawn up by fine curved forceps whence it can be more safely and more easily removed. Failing this, the duodenum may be mobilized by the incision of the parietal perito-



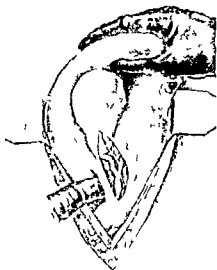


Fig 2 Cholelithotomy Exploration of the bile ducts All ducts and hepatic artery are seen and a finger in foramen of Winslow hold up a stone in common bile duct

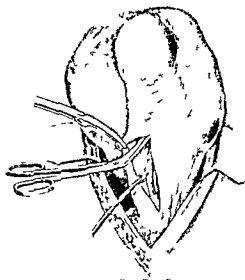


Fig 3 Cholecystectomy and cholelithotomy Method of draining the common bile duct through the stump of the cystic duct shown

during this operation. If there be any doubt it is wise to aspirate with a glass syringe and a long fine needle. If the vein be accidentally opened, the bleeding can be instantly checked if it is seized with the finger and thumb or artery forceps, and the opening is closed with a suture of fine linen thread which is more secure than catgut. A simple longitudinal incision is made into the duct so that the stone often shoots out or is pressed out by the finger behind the duct. Two mattress sutures may be introduced into the wall of the duct before it is incised. These serve to close the incision afterward and also act as valuable guides. I have often used rotation of the duct as recommended by Lord Moynihan with great advantage, for when the gall bladder is shrivelled empty and embedded in adhesions and the patient is too ill for a prolonged operation, the adhesions need not be separated but with the left hand passed to the left in front of the lesser omentum and the fingers flexed the common duct with the stone within it as a guide is pushed to the right and forward into view from behind the adhesions. A suture is passed into the duct wall to anchor it, and an incision is made over the stone in the usual way. Much time and trouble may be saved by this maneuver.

The escape of bile, which may be profuse and often infective if it has been pent up or if the blocked duct is dilated must be met by assiduous

sponging and previous packing of the kidney pouch of the peritoneum. After removal of the main stone the ducts must be thoroughly and systematically explored for as has already been pointed out there are often several stones present and the failure to remove them all will render the operation more or less useless. In late cases of obstruction of the common duct stones may have formed in or backed into the hepatic ducts and may be overlooked and give rise to recurrence of symptoms. This exploration should be carried out with the finger if the ducts are sufficiently dilated or failing this, with a long pliable probe and scoop. The finger, however, should be employed whenever possible, because it is the most certain. It is passed both up and down. By conjoint work from within and without the duct a stone impacted low down may be dislodged and removed. A large olive headed probe should be passed into the duodenum to make certain that the papilla is patent and to enlarge the opening if necessary so that any stone or debris left behind may easily escape into the bowel. It is often wise to clear out debris by means of a gauze strip passed into the duct. W. J. Mayo states 'In nearly one third of the deaths which followed operation on the common duct for stone in one series, autopsy revealed that all stones had not been removed.'

## AFTER TREATMENT

After his return to bed, the patient is placed horizontally upon his right side with only one pillow. He is kept warm and immediately given per rectum one pint of 5 per cent solution of glucose containing 60 grains of sodium bromide and 30 grains of aspirin. This enema is repeated if necessary, the same evening. As soon as the patient is round from the anæsthetic and any shock has passed he is placed in a comfortable semi sitting position. If necessary, heroin  $\frac{1}{6}$  grain is given subcutaneously about 9 p.m. and repeated about 4 hours later and perhaps the second night. This drug, however is reserved for the nights aspirin and bromide being substituted, if required during the day. From the beginning water is given freely by the mouth and the diet is rapidly increased so that full diet is generally given in small meals on the fourth day. This is better than a more restricted diet and avoids trouble with the bowels.

After the first day the rectum is washed out every morning with plain water. Paraffin 1 ounce is given twice a day from the beginning and if this is insufficient 1 ounce of castor oil is given on the third morning. If vomiting is troublesome large drinks of water containing bicarbonate of soda are given freely by the mouth and if this fails the stomach tube is used. If flatulence is troublesome pituitrin is given subcutaneously and a turpentine enema is used and generally affords great relief.

## COMPLICATIONS

Reactionary hæmorrhage rarely follows this operation nowadays, owing to the better preparation of the patient and better hæmostasis but if it does it may be necessary to reopen the wound without delay, to tie any bleeding vessel. In late cases of long continued jaundice oozing of blood may occur at any time up to a week or 10 days after the operation. This is best met by the administration of calcium chloride intravenously, blood transfusion or the injection of hæmoplastin.

Unless great care has been taken in placing the drainage tubes extravasation of bile may occur into the greater or lesser sacs of the peritoneum thus causing diffuse or localized peritonitis. With the former distention of the abdomen tenderness and moderate rigidity with dullness in the flanks soon develop and the abdomen has to be reopened and drained a tube being placed in the lower abdomen. With the latter, the escape of bile into the lesser sac causes great pain and collapse and later an epigastric swelling of the characteristic shape of the lesser sac. This is best drained without delay through a left paramedian epigastric

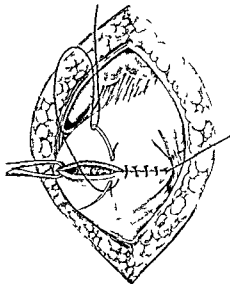


Fig. Duodenocholedochotomy. The wound in the duodenum is drawn into the transverse position and closed with two layers of catgut suture and sealed over with a flap taken from the mesocolon just below it.

incision reaching the lesser sac either below or above the stomach (generally below).

Recurrence of colic sometimes takes place after choledochotomy and this may be due to a spasm of the duct around the tube, blood clot, or even debris of stone in the duct. Heroin or morphia has to be administered to relieve the pain. Remittent or intermittent fever occasionally follows choledochotomy and is usually due to cholangitis. For this the administration of urotropin or sodium salicylate and magnesium sulphate is indicated. In late cases wasting and anorexia, sleepiness and even coma may develop because of cholæmia. These are grave signs which are to be met by the giving of large quantities of water and glucose per rectum subcutaneously or intravenously. Moynihan administers these through a tube passed through the common bile duct into the duodenum.

## PROGNOSIS

**Mortality.** Although many of the patients requiring choledochotomy are bad subjects the mortality from the operation when taken in time is surprisingly small—from 2 per cent to 6 per cent varying with the duration of jaundice, the site of the stone, the amount of work to be done at the operation, and above all the absence or presence of infection of the common bile duct before or after the operation.

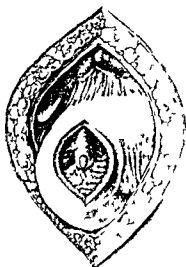


Fig 6 Duodenocholedochotomy The second part of the duodenum is brought into the wound and packed off. Vertical incisions are made in the anterior wall of the duodenum and end of the bile duct.

neum about an inch to the right of the descending part and turning the latter forward and inward (Fig 5). Then the calculus is sought and if found it serves as the best guide to the duct which may be embedded in the head of the pancreas. When the stone has been found it may now be possible to push it back into and to remove it from the supraduodenal part of the duct. If this is not possible the duct must be incised over the calculus, which is removed, and drainage always established. The objections to this route are that it is difficult and may be accompanied by troublesome hemorrhage from the pancreas but usually the pancreatic tissue around the duct is fibrous from chronic inflammation and does not bleed much. Bleeding is best controlled by suture. In some cases it is easier and safer to adopt the transduodenal route as Kocher did in one case on account of severe hemorrhage from the pancreas which made him give up the retroduodenal route.

*Transduodenal choledochotomy duodenocholedochotomy* (Figs 6 and 7). Dr McBurney was the first to perform this operation in 1891. He laid stress upon the following procedure:

In all cases which are not complicated by very deep adhesions involving the common duct and descending portion of the duodenum it is easy and very desirable after determining the presence of the calculus in the lower part of the duct to pass the left

forefinger through the foramen of Winslow to a point behind the calculus. With the finger the lower end of the common duct the calculus and the descending portion of the duodenum can be lifted forward so as to bring these parts nearly or quite to the level of the abdominal incision. The duodenum is then incised on its anterior wall from an inch to an inch and a half the orifice of the duct (which is usually markedly altered as to the color etc) is easily found and enlarged with knife or scissors or forceps and the stone removed.<sup>1</sup>

If an incision has been already made into the common bile duct in its first part a piece of gauze may be drawn downward from it into the duodenum thus removing any debris, but if free drainage is established into the duodenum it is not necessary to make a separate incision for drainage of the common bile duct. When a stone is impacted higher up the duct and cannot be extracted through the incised papilla in this way, it may become necessary to cut upon it through the posterior wall of the duodenum and the anterior wall of the second or third part of the duct after Kocher's method. The edges of the incision in the duct are sewed to those of the wound in the back wall of the duodenum to prevent bleeding and to maintain a free opening into the duodenum. The duct is then explored for more stones by passing up a finger or flexible scoop. The longitudinal anterior duodenal incision is closed in the usual way with two continuous sutures of fine catgut the wound being drawn transversely to the axis of the bowel before it is closed so that stricture may be avoided. A flap of the convenient transverse mesocolon is then sewed over the suture line to reinforce it. This method being more severe and dangerous than opening the bile duct above the duodenum is of course, only suitable for cases in which it is found impossible to back the stone into the first part of the duct without undue force being used. The death rate from this operation will probably remain a little higher than that of supraduodenal choledochotomy because most patients needing it are more ill and exhausted from long continued complete obstruction of the bile and pancreatic secretion. Moreover in the past the risks of death from duodenal fistula and from hemorrhage were greater. But with more accurate diagnosis earlier operation and great care in sewing the duodenum and in preventing hemorrhage, the risks of this excellent operation have been greatly reduced in recent years.

If the duct is not found in the bile duct the peritoneum is lifted and the duct may be incised to the right of the stone.  
J. C. H. Cook, Ann. Surg. 1, 22.

THE TECHNIQUE OF COMBINED ABDOMINOPERINEAL RESECTION OF THE RECTUM<sup>1</sup>

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**D**OGMATIC, arbitrary assertions that any one operative maneuver may be so standardized as to be applicable as a routine in the extirpation of carcinoma of the rectum and rectosigmoid is indicative either of inexperience or of a studied disregard for statistical information on the part of the commentator. Even a cursory glance at mortality tables or morbidity studies emphasizes the necessity of multiple procedures in meeting this surgical situation which is so fraught with technical difficulties and which not uncommonly is associated with serious complications and unpleasant sequelae. Search for an ideal type of operation with low mortality and short hospitalization is unrewarded, and experience indicates that at least five types of maneuver are essential in the handling of these cases. I name them in the order of their desirability, without reference to their application, which should be decided by mature judgment based on clinical experience: (1) abdominoperineal resection in one stage; (2) graded abdominoperineal resection in two or three stages; (3) colostomy and posterior resection; (4) local attack by posterior resection without colostomy as in the Quénu-Tuttle or Harrison-Cripps variety of operation; and (5) palliative procedures such as colostomy, local cauterization, and local excision.

The first three types of procedure mentioned will be the choice of practically all surgeons to whom patients come for relief when the disease is in an operable stage. Local extirpation will be used only in an occasional case because it fails to give information relative to abdominal metastasis and because of the undesirability of leaving an uncontrollable sacral anus. Instances in which this procedure is used will be largely at the insistence of the patient because of his dislike for an inguinal colostomy opening. The field for palliative procedures such as colostomy in case of obstruction as well as destruction by cauterization may be extended to include those groups of cases which are better treated by colostomy and radium or by radium alone. Moreover, in certain instances radium has effected a five year cure when used alone or in combination with a drainage operation, and the tendency is increasing to employ it more frequently in growths proved by biopsy to be highly malignant.

## SELECTION OF CASES FOR OPERATION AND OF OPERATION FOR CASES

Selection of cases for operation is not more important than proper selection of operation for individual cases. Both factors are vital in widening rather than narrowing the scope of individual surgical procedures and in increasing the horizon of operability rather than in diminishing it. In the matter of selecting cases to which each operation is most applicable in the hope that the highest percentage of ultimate cures and the lowest percentage of immediate mortality may be combined, one immediately finds wide divergence of opinion among surgeons and enters on debatable ground in attempting to define or standardize exactly what operability means. Although general rules may be laid down for the vast majority of cases, and little difficulty is experienced in the allocation of the cases, few fields of surgery offer so little opportunity for extreme standardization or demand more varied technique in application or experience in the selection of therapeutic measures.

Obviously, metastasis to the liver, as demonstrated at exploration, rules out subsequent attempts at eradication of the local malignant growth except in extreme instances. In gastric surgery occasionally one may resect a carcinoma of the pylorus as easily as one may do a gastroenterostomy.

In surgery of the colon, however, the analogue is not followed that is resection of any segment of the colon cannot be accomplished with the simplicity, ease and low mortality of a drainage operation proximal to a growth. Involvement of lymphatics does not rule out radical operation since the hope that one may by block dissection remove all of the invaded lymphatics is ever present and on the other hand, one rarely can tell that the lymph nodes are malignant until they have been removed and examined microscopically. Enlarged lymph nodes in the vicinity of a carcinoma mean nothing. More frequently than not, they are benign and inflammatory, secondary to the ulceration which is always present with carcinoma.

The anatomical conformation of the individual although by no means a standard for rejection of a patient for operation or an infallible aid in selecting the type of operation, always influences

E. S. Judd and J. H. Lyons,<sup>1</sup> analyzing the mortalities of operations upon the biliary passages performed by ten surgeons at the Mayo Clinic during 1922 record 4 deaths in 150 choledochotomies.

*Recurrence of symptoms* Recurrence of symptoms after choledochotomy is a rare event nowadays when the operation is performed without delay and before infection of the bile ducts has taken place. When they do occur, they may be due to stones or debris left behind in the biliary passages.

Ann. S. 28, 1923, 1, 2914, p. 194

This is not entirely avoidable on account of the complicated nature of the biliary apparatus and the lateral pouches that may form in the common bile duct. When the gall bladder has not been removed fresh gall stones may form in the gall bladder and cause recurrence of symptoms and this is an important reason for the removal of the gall bladder whenever possible without adding to the risk of the operation. Recurrence of symptoms may also be due to spread of infection to the pancreas or to adhesions between the pylorus or duodenum and the liver at the site of the gall bladder.

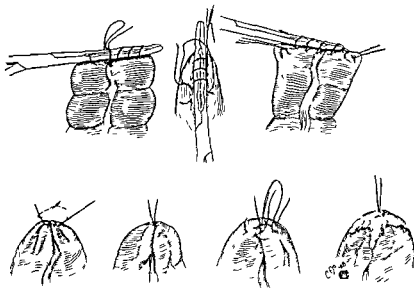


Fig 2 Steps in the application of suture and inversion of bowel stump

is a small series in the clinic which has not been operated on at all but has been subjected entirely to treatment by radium. The series is too small and the time too short to warrant an opinion as to the utility of these measures; however, I believe that in the present state of knowledge concerning prognosis in carcinoma of the rectum, these highly malignant tumors are better treated by a combination of radium and surgical procedures or by radium alone than by an extensive and highly difficult technical operation.

My practice has been to make a biopsy of the tumor at the time of the proctoscopic examination. The biopsy is done not so much with the idea of making a diagnosis because with the proctoscope and examining finger one rarely needs further evidence that carcinoma is or is not present but with the idea of securing tissue for microscopic examination to ascertain the grade of the carcinoma. Only an extremely small amount of tissue is necessary and this may be obtained very easily and without undue trauma, by means of a cautery knife. I do not believe that there is much if any danger of spreading the malignant cells by removal of this small piece of tissue.

Although one would hesitate to cut into a carcinoma of the breast or to open a colon to obtain a piece of tissue, I believe that the situation is entirely different in rectal carcinoma. I doubt very much if biopsy produces as much trauma as the constant passing over the area of the hard column of fecal matter which irritates it daily, or if

biopsy offers any greater likelihood of spread of the disease.

#### GRADING OF MALIGNANT CONDITIONS

I believe that the grading of malignant conditions permits widening of the horizon of operability. It permits the undertaking of radical

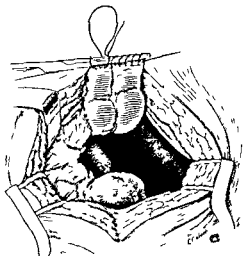


Fig 3 The distal end has been turned in with a purse string suture and dropped back into the free peritoneal cavity. The proximal end is being turned in with a running Cushing suture which makes it more readily handled than if the clamp is left on.

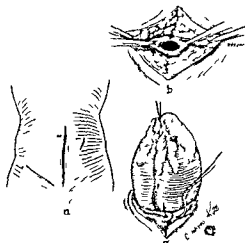


Fig. 1 a Median line incision for exploration and other steps of operation. Stab wound midway between umbilicus and anterior superior spine for colostomy. b Small opening in peritoneum through which the sigmoid is drawn. The other layers of abdominal wall are incised more widely to prevent constriction. c The closed off proximal sigmoid is brought out through the stab wound and the peritoneum is closed snugly around it without the application of sutures into the wall of the bowel. Other layers are closed loosely or an iodoform gauze pack is wrapped around the bowel and the wound is permitted to heal by granulation.

one's judgment of which procedure can be accomplished best and most safely. Short persons, inclined to obesity, present poor risks for any surgical procedure. It is a clinical observation that patients of this type who harbor malignant neoplasms not only stand extensive technical procedures poorly because of lack of resistance and because of the ease and rapidity with which local infection often proceeds to lethal peritonitis but the ultimate prognosis in such cases is relatively poorer than for the thinner, muscular type of patient. I do not know that there is any anatomical type which may be called a cancer type, but the types that are poor risks for surgical procedures in chronic disease are a higher risk for surgical procedures involved in the removal of malignant tumors.

Most patients suffering from carcinoma are beyond middle life and are undergoing retrograde changes of approaching senescence—a fact to their advantage since the less active tissues more readily resist invasion of carcinoma than the elastic vitality of youth. Persons who have pursued laborious tasks necessitating much exertion for a long period of time and who retire to sedentary life, and subsequently develop carcinoma should be considered as presenting high risks invariably their resistance is much lower than one would

ordinarily judge. Many other factors enter into the task of gauging patients' general resistance to carcinoma such as prolonged concurrent disease. Examples are diabetes, nephritis, marked evidence of focal infection, or other debilitating conditions which would not ordinarily prove to be great handicaps.

The age of the patient long has been recognized as a factor in malignancy. It is well known that young persons, although capable of standing wide extirpation, have a bad prognosis because of the likelihood of spread of the carcinoma in active tissues. I have recently reviewed the cases of carcinoma of the rectum in young persons at The Mayo Clinic, and although I am not able to report in detail the unhappy trend of the curve in the prognosis is apparent.

Of all factors which modify the selection of operation as well as the employment of other agents in combating carcinoma, I believe the relative intensity of the malignant invasion as estimated by Broders' index of malignancy, is the most important. One gains little when, by brilliant technique, one succeeds in extirpating without immediate mortality an intensely malignant tumor in a young man if one knows that the outcome shortly is death and in such an extremely high percentage of cases that there is small argument in favor of employing radical surgical procedures at all. My own feeling is that malignant conditions of the rectum, graded 4 and those graded 3 likewise, under certain conditions are best not treated by radical measures. These types of tumor are more highly radiosensitive and less susceptible to surgical eradication, consequently it has been my practice for the last 2 years to refer patients with these conditions for treatment by radium, in the hope that such treatment may accomplish more either in palliation or cure than surgery could offer. Of course, if obstruction is subacute, or complete obstruction is imminent one should not hesitate to perform colostomy prior to the administration of radium, especially since the first action of radium is to produce edema and swelling of the tissues with concurrent stenosis of the intestinal canal. This occasionally will necessitate emergency colostomy if it has not already been performed prior to the administration of radium. For this reason I believe it highly necessary that the amount of obstruction be accurately gauged before administration of radium and if the impingement on the lumen of the intestine is deemed sufficient, that the operative measure be employed first. Occasionally these patients without obstruction are successfully treated without colostomy and there

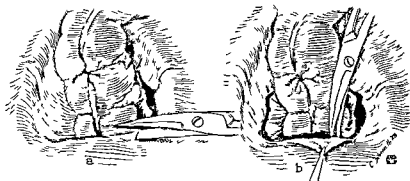


Fig 6 Incision of the lateral parietal peritoneum. a The ureter may be seen. Ureters should always be identified on both sides. b Bowel is being separated from the bladder by division of the peritoneal attachment to that viscus.

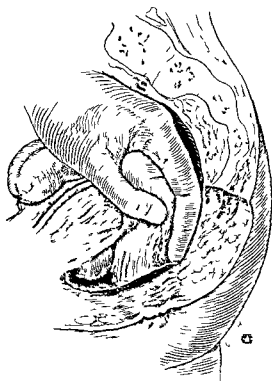


Fig 7 Hand dissection of the hollow of the sacrum following division of the bowel and ligation of its blood supply. After identification of both ureters and tying the blood supply one finds a line of cleavage between the layers of peritoneum which closed the rectum, and blunt finger dissection readily cleans out the hollow of the sacrum and it can be carried forward well down to the pelvic floor in an almost bloodless manner.

Institution of the injection of intraperitoneal vaccine as a routine has, I believe, proved of value. However, whether or not it is sufficiently valuable to warrant its continuance has yet to be determined.

Anæsthesia is another problem of vital importance to weakened patients who present a poor risk. My feeling is that spinal anæsthesia has proved of enormous advantage in my hands in dealing with carcinoma of the large bowel and rectum. Following the suggestion of Miles and others, I have employed it as a routine for 2 years in cases of carcinoma of the colon and rectum. Freedom from pulmonary complica-

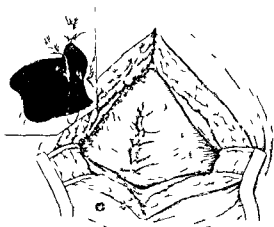


Fig 8 Operation completed. Accurate peritonealization is shown; this really forms a new floor at the brim of the pelvis. A row is made for saving adequate peritoneum during mobilization and previous steps of operation. There is always sufficient peritoneal covering for this step to be accomplished without difficulty.



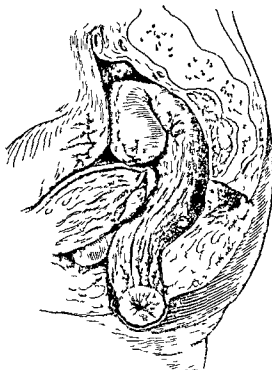


Fig. 4. Sagittal section showing the bowel with carcinoma at the recto-sigmoid junction and the relationship of various anatomical structures. At this point where the bowel has been turned in and dropped back operation may be suspended as a graded procedure or may be completed as a one stage combined abdominoperineal resection.

extirpation of huge fixed growths which are not too immobile because it shows them to be of a low grade of malignancy. The tendency to undertake such difficult technical procedures should not be discouraged if there is a relatively satisfactory chance of ultimate success but I have not seen good results from extreme attempts to eradicate carcinoma of the rectum graded 4 and 3+. Fixation which sometimes makes one feel that the local growth is inoperable is I feel confident much oftener the result of inflammatory change than of malignant extension. For this reason I believe one should be willing to undertake difficult operative feats in low grade carcinomata of the bowel.

Fortunately the size of the growth means nothing as regards its grade of malignancy, and I am not at all sure that statistics would not prove that more rapidly growing and metastasizing growths are of comparatively smaller size than otherwise. Frequently a carcinoma which is small, mobile, and apparently localized is found

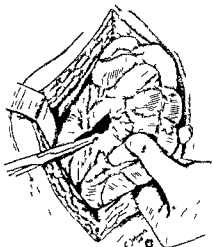


Fig. 5. Ligation of inferior mesenteric artery a step readily carried out after identification of the vessel a little above the promontory of the sacrum. The vessel may be punched off first to be sure that the blood supply to the proximal sigmoid is adequate. Sigmoidal branches should not be tied in the main ligature but the point of ligation is between the superior hemorrhoidal and sigmoidal vessels.

to have invaded the lymph nodes and likewise to have caused hepatic implants. Far from discouraging radical surgical procedures where there is an opportunity for ultimate success, I believe by better understanding of the type of pathological change with which we are dealing we may increase sensibly the horizon of operability.

#### PRE-OPERATIVE MEASURES AND THE ANAESTHETIC

Selection of types of operation undoubtedly if properly applied enhances the chances of successful outcome but operation, regardless of its type and application, is but a single step in eradication of the local malignant growth. Necessary pre-operative measures and an anaesthetic which eliminates many untoward complications increase to a high degree the chances for ultimate cure. To these measures must be added an operation compatible with no more than a reasonable risk of immediate mortality but which at the same time, eradicates widely not only the local malignant growth but the tissues and lymph nodes in immediate juxtaposition to it.

Pre-operative measures under co-operative management aim at (1) rehabilitation of the patient's general resistance which is usually undermined by the dehydration and anaemia incident to the malignant process, and (2) elimination of as much local infection as possible by medicaments or drainage.

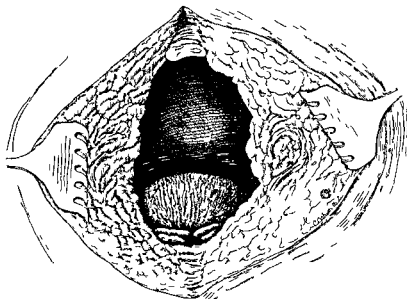


Fig. 11 Operation completed. The posterior side of the new perineal diaphragm the base of the bladder and anal orifice are shown



Fig. 12 Closure of wound and drainage

product of a gradual evolution from the anterior type of resection. This I had been able to carry out successfully in a large number of cases with low mortality because of improved pre-operative preparation and better selection of cases for this type of procedure. I found that in properly selected cases satisfactory removal of the growth at the first stage could be successfully undertaken in a great many instances. In case the colostomy was made at the time of exploration and it seemed inadvisable to carry on the operation for removal of the growth, the operation developed into a three stage instead of a two stage operation as judgment dictated with removal of the lower segment at the second operation or as a separate step still later.

Exploration through a low median line incision is carried out and the liver is examined as the preliminary step before palpation of the growth or viscera in its immediate vicinity is undertaken. I feel that this sequence is important and that the gloved hand should be introduced into the upper part of the abdominal cavity before being carried down into the pelvis where the infected carcinoma lies and from which organisms may be transmitted by direct contact to other portions of the peritoneal cavity.

If it is thought advisable to carry out the resection at the first stage the operation is readily accomplished by the steps in the order

already named. Preliminary ligation of the inferior mesenteric vessels a little above the promontory of the sacrum assures bloodlessness in the vast majority of instances during the subsequent stages of removal. Ligation of this vessel should be made above the superior hemorrhoidal branch but below the sigmoidal branches, thus insuring adequate blood supply to the intestine at the colostomy opening. I have found it better to retract the bowel and mesentery to the left, to lift up the peritoneum and divide it thus exposing the vessel, and to elevate it on a finger by blunt dissection before applying the ligatures. Double ligatures are applied and the vessel divided between them. An additional ligature is put on the proximal stump of the vessel particularly if there is any amount of fat around the site of the first one because of the tendency of vessels to retract in the fat and make for a subperitoneal hematoma.

At this point in the operation the incision in the peritoneum on both sides of the mesentery of the bowel is carried forward to the bladder and the ureter on either side is identified all the way from the brim of the pelvis to its entrance into the bladder. Following this the bowel is lifted and with a hand behind it, in the hollow of the sacrum all the tissues fat and lymphatics in this neighborhood are dissected up by blunt dissection. The hand is carried downward and

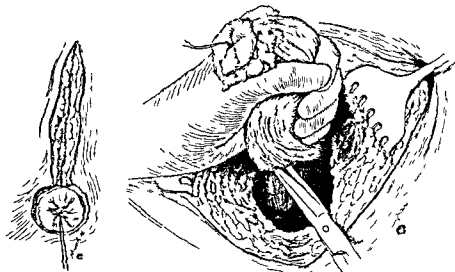


Fig. 9 left Posterior incision for removal of segment of bowel to be sacrificed. This is identical with incision for usual posterior resection.

Fig. 10 Mobilization of lower part of rectum after completion of abdominal portion of operation. Here the

bowel is shown being dissected away from the bladder. The seminal vesicles are shown in the bottom of the field. Steps of ordinary resection are carried out as though the first portion of the operation had not already been completed.

tions, increased ease of surgical approach, and better postoperative convalescence convince me that its continuance is highly desirable. The advantages and disadvantages of the different types of operation for carcinoma of the rectum and rectosigmoid I shall not discuss in detail but shall leave with the assertion that the principles of the operations described by Jones and Miles are unquestionably fundamental in dealing with malignant conditions in these sites. Block dissection of all the zones of lymph nodes draining the growth and, at the same time, wide removal of the growth represents the ideal operation in this situation. That its application must be accompanied by most rigid and common sense selection of cases and that there must be acceptance of a considerably higher immediate mortality rate than in gastric or pelvic surgery is indisputable. At the same time, the relatively high number of satisfactory five year cures or of freedom from recurrence which follows extirpation of carcinoma of the rectum and rectosigmoid by any of the approved methods urges a more earnest effort to bring patients with these lesions to operation earlier and in better condition in order that the most radical type of surgery may be employed.

In a series of cases in 1927, I removed carcinoma of the rectosigmoid by an anterior type of resection either in one stage or in multiple maneuvers. The immediate success and the experience gained

convinced me that extension of this type of operation was applicable in many cases of rectal carcinoma, in fact, in the same type of rectal carcinoma in which Jones and Miles each urges his own individual procedure. The steps of the operation group themselves readily: (1) incision and exploration, (2) ligation of the blood supply and mobilization of the growth, (3) resection of the growth, (4) colostomy obstructive colostomy and resection if the operation is to be done in one stage, or if the colostomy has already been accomplished 2 or 3 weeks previously and this is the second stage of the extirpation, removal of the distal stump, (5) peritonization of raw surfaces, (6) treatment of rectal stump removal of the rectal stump or of the whole growth after closure of the abdominal incision and turning the patient over on his face or if completion of the operation at this time is inadvisable and if the resection has been done in front leaving a small rectal stump institution of drainage by a stab wound between the anus and coccyx, (7) in the event that the posterior stump has been left and the other steps of the operation have been completed at one stage, removal of the posterior stump as a separate step 10 days later.

#### ONE STAGE OPERATION

My practice in applying the abdominoperineal technique to carcinomata of the rectum is the

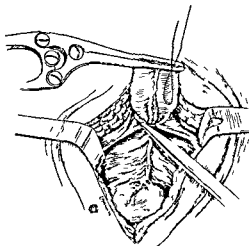


Fig 15 Peritoneum is wrapped around the upper loop on which the clamp is left

same stage, a circular incision around the anus, similar to the incision used for posterior resection, is employed. It is not necessary to remove the coccyx. A catheter has previously been placed in the bladder and there is small danger of wounding the urethra. This excision of the rectal stump requires only 5 to 10 minutes if done at this stage, and if left for a subsequent stage 3 to 5 minutes. It is more easily accomplished at a later stage because of lack of bleeding at the second operation. After its wide mobilization at the second operation it peels out very easily, once a line of cleavage is established. I feel confident that this type of drainage is more satisfactory than the one I formerly employed namely the method of bringing out drains through the abdominal wall and draining by way of the abdominal cavity. I have not had an unfortunate experience with closure of the cavity following this type of operation which would make me want to abandon it.

#### MULTIPLE STAGE OPERATION

Should it seem advisable either before exploration or at exploration, that the malignant growth be removed by a graded procedure, the first step of which is colostomy, the operation is modified somewhat. However, the principles are carried out very much in detail as in the one stage procedure with the exception of the type of colostomy employed and the time of removal of the lower segment. I have found two types of colostomy satisfactory in making a two stage or three stage resection by the combined abdominoperineal route. First, the ordinary type of

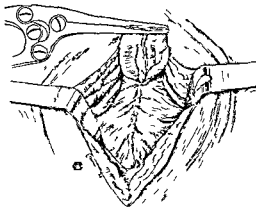


Fig 16 Closure of wound the proximal stump of bowel being left out and the peritoneum and other layer sutured around it

colostomy by which a loop of bowel is brought out through a split muscle incision or through a stab wound in the left groin, the latter provided exploration has been made through a median line incision. This loop is brought out and allowed to remain as long as 7 or 8 days if the patient will stand discomfort that long. Gas passes through the loop if it is not made too tight, and it is not necessary to open it any time up to the third or fourth day and frequently not until the eighth or ninth day. Women stand the discomfort more readily than men rarely does a colostomy loop have to be opened in the case of a woman in less than a week.

The point I wish to emphasize about this ordinary type of colostomy is the removal of the distal stump, which is a blind pouch, after resection of the sigmoid and rectum. This little stump, which is the end of the bowel below the division made at the time of the colostomy

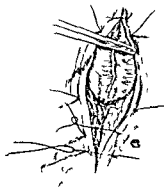


Fig 17 Operation completed wound being closed

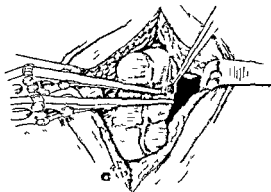


FIG. 13. Division by cautery of bowel between clamps. The distal end may be dropped down into the free peritoneal cavity while the proximal end is brought out through the incision after being closed or the clamp may be left on as the operator chooses.

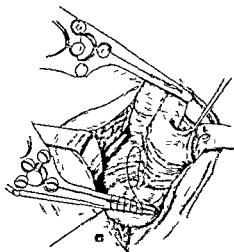


FIG. 14. The distal end of bowel being inserted with over-and-over suture while the peritoneal attachment which runs from the mesentery to the sigmoid of the lateral parietal peritoneum is being held up taut.

forward until the dissecting fingers are felt to slide over the coccyx and down onto the floor of the perineum.

The lateral incisions are now extended forward and the peritoneal attachments holding the bowel to the bladder are divided with scissors. Here further blunt dissection frees the bowel all the way around, and it is elevated until a point is reached that is well below the growth and where division of the rectum would leave a rectal stump of only 5 to 8 centimeters behind the division. Two clamps are placed on the bowel at this point and it is divided between them. With the bowel elevated a place for colostomy is selected, this must be at a point where, by visual inspection, it can be seen that the blood supply will be sufficient to the proximal end of the severed intestine. Here the bowel is divided between clamps, permitting removal of the invaded segment and its lymphatics, fat, and adjacent tissues *en masse*. The proximal end, which is to remain as a colostomy, is now turned in with two layers of pursestring sutures. A hot pack, in the meantime, is placed in the pelvis to take care of any venous oozing which may be occurring there and a stab wound is made in the flank through which the stoma, made by the colostomy, is drawn. I have found it most satisfactory to make a stab wound which cuts directly through the muscle and fascia but which makes a very small hole in the peritoneum. When the proximal end of the cut intestine is pulled out through this small stab wound, the peritoneal coat fits snugly around it, but the other coats are loose and do not impinge on the lumen. Instead of placing sutures in the bowel, I have found it better to wrap it in gauze and permit healing

to take place by granulation. The granulation around the colostomy opening is slow but the gauze pack is an advantageous guard against leakage when it is necessary to open the bowel at the end of 48 hours, as it rarely is. The rectal stump is now turned in, and decision is made as to whether or not it is desirable to do the operation in one stage or in two stages. The next important step is adequate peritonization of the pelvis covering over the raw surfaces and making a new peritoneal diaphragm, which is in reality a new pelvic floor several centimeters above its former site.

I have always found it possible to make satisfactory peritonization. Several times when the step was begun it looked as though it would be impossible, but with patience and sutures one can invariably cover the floor in a perfectly clean and satisfactory manner. The omentum is now brought down into the pelvis to keep the small bowel away from the site of operation as much as possible and the wound is closed and sealed off with collodion in an effort to keep it free from being subsequently infected.

The patient is now turned on the side or the face as one chooses, and the operation is completed either by removal of the rectal stump or by the institution of drainage alongside it into the hollow of the sacrum. Drainage is usually satisfactorily accomplished by insertion of two small tubes of rubber tissue. If it has seemed wise to proceed with removal of the rectal stump in this

ties of fluid by mouth. Up until this time, however, the water balance is maintained by the administration of glucose and physiologic solution of sodium chloride intravenously, subcutaneously, or both. Drains are removed on the fifth day unless iodoform gauze packing has been instituted to control bleeding in case of complete operation in one stage. Should gauze be used, its removal is best left until the seventh to ninth day, since by that time it is usually saturated with secretions and may be readily removed without pain. In the event that it sticks to surrounding tissues, irrigation with physiologic solution of

sodium chloride will loosen it and will permit its removal. The large cavity which contained the rectum must be filled in by granulation tissue. Subsequent treatment by irrigations, sitz baths and other agents which permit rapid healing and increased comfort is given as a routine.

With adequate co-operative management, satisfactory pre-operative preparation, careful selection of cases for operation and of operation for individual cases, I am convinced that the abdominal type of resection either as a single or graded operation, is adaptable to an increasingly large percentage of cases.

## A METHOD OF USING THE SAME VEIN REPEATEDLY FOR INTRAVENOUS MEDICATIONS

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**B**LOOD saline glucose, and other intravenous medications have become very important factors in the treatment of various medical and surgical conditions. It is often necessary to give these treatments daily and sometimes two and three times a day. Occasionally one finds patients who are so fat that the superficial veins can not be palpated or recognized and others who are in such severe shock that their veins are collapsed. In these patients it is nearly impossible to give repeated intravenous treatments without cutting down on to a vein.

Under these circumstances it is my custom to use the method which is clearly demonstrated by the accompanying drawings.

Figure 1 shows an incision made over one of the superficial veins, usually the medium basilic. A plain catgut suture is passed around the vein in the lower angle of the wound and the vein is tied off. Mosquito forceps are used and the vein is grasped just above the tie and a V shaped incision is made between the ligature and the supporting forceps. It is advisable to use small sharp scissors for the incision of the vein.

Figure 2 shows the cut flap in the vein retracted upward and the cannula ready for insertion into the lumen of the vein. The solution is then allowed to run in.

Figure 3 shows a black silk suture placed through the skin and superficial fascia opposite

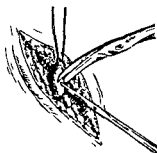


Fig. 1

Fig. 1 Exposure of vein  
Fig. 2 The cut flap retracted upward. Cannula ready for insertion.

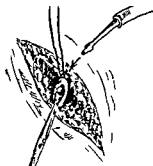


Fig. 2



Fig. 3

Fig. 3 Black silk suture placed through skin and superficial fascia opposite base of flap in vein then under vein to come out on other side of wound.

and which usually has been turned in with two or more layers of sutures, leaving a projection into the peritoneal cavity, should, I believe always be removed, even at the expense of more operating and slight increase in risk. I form this conclusion from a case in which the patient died from perforation of this stump, as shown by postmortem examination, death was found to be due to general peritoneal contamination. Usually one can be relatively sure of the blood supply to this blind pocket, but since one cannot always be sure of this I am not willing to leave it in place because of the occasional danger of perforation. It is easily removed at the second stage of the operation by dividing the blood vessels close to the peritoneum and then by invaginating the loop through the abdominal wall, closing behind it with two mattress sutures. The small piece of bowel is then left adherent on the anterior abdominal wall for 3 or 4 days and then is removed by cautery. The peritoneum, in the meantime, has been sufficiently sealed off to prevent danger of contamination.

Another type of colostomy which I have found satisfactory in these cases is made by dividing the bowel at the time of exploration and turning in the distal end whereas the proximal end is brought out and left. A single barreled colostomy is made in this proximal end when it is opened after 48 or 72 hours as necessity demands. By dropping back the distal end of the loop of bowel into the peritoneal cavity, one has an opportunity still to irrigate the growth through rectal injections and thus to carry out the cleansing program which is advisable. At the same time the very satisfactory single portion of bowel which is allowed to project is left closed until necessity demands that it be opened. The length of bowel in this single barreled colostomy which should be allowed to project out of the abdomen is a question of which I am not entirely sure but occasionally a very long, projecting portion will be found advantageous in that it may be allowed to hang free in a colostomy bag and make for ease in taking care of it. At the same time a short portion, close to the skin is readily taken care of by a tight fitting pneumatic colostomy apparatus. If colostomy is made through a stab wound which is small and fits snugly around the bowel, hernia is much less common. I have seen a great many hernias develop in left rectus and even in split muscle colostomies as a result of long standing continued pressure from colostomy apparatus. Of necessity, these devices must fit very tightly around the bowel and they vitiate the resistance of the abdominal wall, with the

result that weakness and separation follow after months or a year of application. If the single barreled colostomy is used one either may turn in the end of the proximal loop with a pursestring suture, which may be divided by cautery at the proper time, or one may simply leave a heavy clamp on the end. Either method is satisfactory and the subsequent steps of resection are identical with those described in the one stage operation. I have found that the distal end usually adheres snugly to the peritoneum, as one does not divide much blood supply in making a colostomy of this type and care must be taken in separating it from its attachment or the ends may be opened inadvertently. In ligating the blood supply to this distal end ligature must be placed close to the bowel until one is away from the immediate vicinity of the colostomy so as not to encroach on its nutrition. Having made the colostomy and waited a sufficiently long time resection is undertaken through a low median line incision and is carried out as already described. If the growth is at the rectosigmoid juncture one may leave the short stump of rectum for drainage posteriorly subsequently removing the stump or not as seems wise. However, if the growth is in the rectum, resection should consist of complete removal of the segment below the colostomy and sufficient time should be permitted to elapse between the two stages of the operation to allow for recuperation and rehabilitation up to a point at which the patient is capable of standing a prolonged and difficult technical maneuver.

#### POSTOPERATIVE CARE

Postoperative attention following colonic resection is a necessity, contributing to shortening of hospitalization as well as to influencing in some degree the immediate prognosis. The cardinal feature of postoperative care is, I believe, satisfactory immobilization of the gastro-intestinal tract during the first few days. Spinal anesthesia contributes splendidly by producing temporary paralysis over a varying period of time, occasionally as long as 48 hours. Morphine necessary for pain, should be liberally used, since not only does it promote comfort but it likewise inhibits peristalsis. Total abstinence from food and drink is highly essential and should be insisted on until the fourth or probably the fifth day has been completed. I have found that when the patient begins to pass gas by the colostomy opening or by rectum if the operation has been on the colon provided the temperature and pulse rate are within reasonable limits small harm is ever done by beginning the administration of small quan-

## OSTEOMYELITIS OF THE ISCHIUM AND PUBIS

A NEW OPERATIVE TECHNIQUE AND A STUDY OF THE SURGICAL ANATOMY<sup>1</sup>

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ACUTE osteomyelitis of the ischium and pubis is difficult to diagnose before destruction of bone is evident by roentgen ray examination or before an abscess has formed. This difficulty is due to the following facts: (1) osteomyelitis of these bones is infrequent; (2) the bones in question are rather inaccessible; and (3) the symptoms of osteomyelitis in these bones are similar to those of inflammation of the hip joint.

Early operative treatment is important in order to avoid sepsis, pyæmia, chronic osteomyelitis, and other complications. Surgical interference, including that for osteomyelitis, is rare in this region which undoubtedly accounts for the fact that there is no recognized technique for operative exposure of the pubis or ischium.

The present study includes a report of 4 cases, with a description of the surgical anatomy of the pubis and ischium and an original and satisfactory method of operation. The ischium was involved in all cases, with extension to the ramus of the pubis in one instance.

**CASE 1.** Acute suppurative phlebitis of the left leg. Septicæmia. Acute suppurative osteomyelitis of the left tibia, the right pubis and ischium. Non suppurative osteomyelitis of the left clavicle.

A St. J. aged 11 years entered the Presbyterian Hospital March 18, 1928, complaining of pain and swelling of the left leg and ankle with fever which had been present for 3 days. There was no history of injury although she thought she might have twisted her ankle slightly in the gymnasium a few days previously. There was no pain until the ankle began to swell. One month previously she had suffered from an acute earache. A doctor at that time found a catarrhal otitis media but no rupture occurred. Since then she has not felt so well as usual. There was no history of any infectious disease. The tonsils and adenoids had been removed several years previously.

Examination disclosed the following: Temperature was 104.2 degrees. The left leg was swollen and oedematous over the medial and anterior side and this condition extended down over the ankle. There was putting on pressure. Tenderness was present over the swollen area but it was not localized over the tibia. Pain was marked on any movement of the leg. The inguinal glands were enlarged. The white blood count was 30,000. The urine contained a trace of albumin. The temperature was 104.4 degrees the following day. A roentgenogram of the tibia and ankle taken on the fourth day of illness was negative.

Operation was performed March 19, 1928. Exploratory incision of the ankle was negative. The sphenous vein was opened again just below the knee and while the walls were found oedematous, no gross pus or blood was present. There was no evidence of an abscess at any

point involving the tibia. Smears and cultures of the pus from the vein showed a staphylococcus aureus. Microscopic examination of the vein near the ankle showed a polymorphonuclear leucocyte infiltration of the wall and a thrombus firmly attached to it.

After operation there was some improvement and the temperature became lower. Some fever persisted however for the next few weeks with little change. Blood cultures 2 days after operation showed a staphylococcus aureus. The upper incision on the leg healed while the lower incision became covered with granulations but did not heal. Six weeks after the onset, the leg became swollen again. There was little change in the fever and a pocket of pus opened at the side of the wound. During the fifth week a swelling due to osteomyelitis developed over the medial end of the left clavicle. This varied in size several times during the next few weeks but gradually subsided without suppuration. Pain developed in the right hip about 4 weeks after the onset of the symptoms in the left leg, but with little change in the fever. The pain would become worse for about 2 days when the patient would have to stay in bed. It would gradually lessen and the patient would be able to walk around with a limp. After about 8 weeks the pain became worse and the thigh became quite flexed.

Patient again entered the hospital June 21, 1928.

Examination at this time showed the right hip flexed about 40 degrees as a result of muscle spasm. Pain was felt on any motion of the hip. Tenderness was most marked over the inner side of the thigh about the origin of the adductor muscles. No tenderness was present posteriorly over the neck of the femur. There was some purulent discharge from two openings over the lower half of the left tibia. A roentgenogram showed areas of thickening and rarefaction of the inferior ramus of the right pubis and both rami of the ischium, with some new bone formation. The right obturator foramen was darker than the left suggesting an abscess in this region (Fig. 1).

Operation upon the pubis and ischium was done on June 21, 1928. In order to approach the pubis and ischium the adductor muscles on the medial aspect of the thigh were split. The external obturator muscle was seen to be bulging forward and when its fibers were split about an ounce of thick pus was found beneath it in the obturator foramen. The inferior rami of the pubis and ischium were exposed and several holes were drilled in the region of the honeycomb-like areas shown in the roentgenogram. A small rubber tube was kept in the wound for several weeks for drainage and irrigation. A slight sinus persisted for several weeks after its removal but healing of the pubis and ischium was complete at 5 months. After operation immediate relief was obtained from the pain and all movements of the hip became normal.

An operation was performed upon the chronic osteomyelitis of the tibia on August 14, 1928. Several sequestra were removed from the sides of the medullary canal. The involved area of the lower one half of the tibia which did not extend into the cancellous bone of the metaphysis was saucerized. Ten months later there was still a slight discharge from a narrow granulating area over the lower part of the tibia. The general health was excellent.





Fig. 4 Bow knot tied over vein and skin

the base of the flap in the vein and then under the vein and to come out directly opposite on the other side of the wound. The cannula is removed and the mosquito clamp on the cut flap of the vein is retracted downward. The skin suture is tied approximating the skin edges over the incised vein tight enough to prevent backward leakage of blood from the vein.

Figure 4 shows a bow instead of a square knot tied over the vein and skin. When another intravenous treatment is necessary the bow knot is untied and the skin edges gently retracted thus again exposing the vein. The V shaped flap in the vein is again picked up by mosquito forceps, elevated, and the cannula reinserted into the vein.

Such a vein may be used innumerable times in this manner if the procedure is done correctly and without undue trauma. If the sides of the vein adhere it is very easy to push the cannula gently through this obstruction.

There is but slight pain or discomfort connected with the procedure. The skin is infiltrated with novocain before the original incision is made, but no anesthesia is needed for the repeated use of the vein. It is well to resterilize the operative field before and after each treatment.

ment of the ischium and pubis each two times in 385 separate lesions of osteomyelitis in 320 children. Lloyd in 29 cases of osteomyelitis reported 2 cases with involvement of both the pubis and ischium. Ogilvie in 51 cases reported involvement of the pubis in one case. Platt in 41 cases of osteomyelitis found no involvement of pubis or ischium although the ilium was involved in 4 cases.

Doran and Brown noted that there was a chronic osteomyelitis of the ischium in 3 out of 71 cases of osteomyelitis in childhood. They, Ogilvie and others have observed that a recent furunculosis, tonsillitis or otitis media often appeared to be the primary infection in osteomyelitis. A history of local trauma was also common. Raeschke described an osteomyelitis of the pubis following measles.

In the writer's 4 cases there were 2 boys and 1 girl 9 to 14 years of age, and one woman aged 44 years. Multiple foci of infection developed in all cases. In Case 1, there had been a catarrhal pharyngitis and otitis media one month previously. The onset was associated with a suppurative thrombophlebitis. This may have extended to or from the osteomyelitis of the tibia. The right pubis, ischium and clavicle developed infection several weeks after the onset. A staphylococcus aureus was obtained shortly after the onset from blood cultures from the phlebitis over the tibia, and later from the abscess resulting from the osteomyelitis of the pubis and ischium and also from the tibia.

Ogilvie stated that in all London Hospitals the staphylococcus was the cause of osteomyelitis in 90 per cent of all cases while the pneumococcus and other bacteria were rarely found.

The osteomyelitis of the ischium in Case 2 probably resulted from a tonsillitis. The osteomyelitis of the ischium in Case 3 probably resulted from an encapsulated abscess in the thorax of 2 months duration. In Case 4 the osteomyelitis of the ischium occurred 9 years previously following multiple foci of osteomyelitis all over the body. There resulted only the chronic osteomyelitis of the ischium with a sinus which may have been the source of the present acute osteomyelitis of the femur.

#### PATHOLOGY

In Case 1 both rami of the ischium and the inferior ramus of the pubis were involved (Fig. 1). Osteomyelitis involving the body of the pubic bone was observed by Phemister in a patient with an abscess forming within the pelvis and following downward along the rectum to point externally.

The associated osteomyelitis of the tibia in Case 1 involved the lower one half of the shaft beneath the phlebitis but with no involvement of the metaphysis. This lends support to the possible origin from a retrograde suppurative phlebitis. Platt stated that while the metaphysis was nearly always the site of osteomyelitis, in older children the infection may reach the shaft of a long bone by the nutrient artery and develop near the middle of the shaft spreading toward the ends.

In Case 2 the superior ramus of the ischium was involved (Fig. 2) with later extension to the body of the ischium including the hip joint and destruction of the articular cartilage without abscess. The clinical picture of this extension of the disease to the hip and the roentgenological changes resembled very closely the type of acute non-suppurative ankylosing arthritis described by Stern.

In Case 3 the roentgenogram showed an area of bone destruction near the tuberosity of the ischium (Fig. 3).

In Case 4, there was a chronic sinus and the roentgenogram showed a sequestrum surrounded by a cavity in the inferior ramus of the ischium, and proliferative changes along the ramus. The other old osteomyelitic foci were healed. Raeschke stated that in flat bones sequestra are frequently absent because of the spongy structure of the bone. He observed in the roentgenogram periosteal thickening after 11 days and irregular destruction after 24 days.

The roentgenogram in Case 4 showed an old extensive hypertrophy of the margins of the head of the femur on the side of the chronic osteomyelitis of the ischium which gave it a mushroom-like appearance. No interference with hip function was observed.

The spread of osteomyelitis may be explained according to Starr by the subperiosteal extension of infection with secondary invasion of the shaft through the Haversian canals.

The associated bacteremia and toxemia may prove fatal in the fulminating types before the development of gross suppuration in the bone, although infection is present and drainage indicated.

#### SYMPTOMS

The onset of osteomyelitis in the ischium developed subacutely in Case 1 following other foci of osteomyelitis. The onset was associated with a recurrence of high fever and toxemia in Case 2, following a recent attack with pains in the bones of the arms. An abscess of the ischium developed in Case 3 with acute symptoms and an

**CASE 2** Primary acute osteomyelitis of the ischium followed by a non suppurative ankylosing arthritis of the hip. Tuberful tonsillitis

J. S., male, aged 14 years. The chief complaints on entrance to the hospital were fever, pain and tenderness around the hip. The onset was about 2 weeks ago with the development of severe pains in the left shoulder and the right wrist. These cleared up, but 2 days later acute pain developed about the left hip with a fever of 103 to 104 degrees for several days. Some relief was obtained by cold applications but 5 days later after an attempt to walk the fever and the pain returned.

Examination disclosed a temperature of 101.6 degrees and a white blood count of 12,200. Any attempted movement of the left hip produced muscle spasm and pain. Tenderness was more marked medial to the thigh in the groin and anteriorly over the joint. Some deep tenderness was present along the left side of the abdomen in the region of the iliopsoas muscle. No evident tenderness could be found over the neck of the femur posteriorly.

A roentgenogram about 12 days after the onset showed areas of rarefaction and destruction in the superior ramus of the ischium (Fig. 3) with some new bone formation along the outer border. The patient appeared quite toxic with a high remittent fever. After 2 days of observation operation with drainage of the ischium seemed indicated.

The ischium was operated upon by the method of splitting the adductor muscles on the medial aspect of the thigh. The obturator fascia and muscle were split and the outer surfaces of the rami of the ischium and pubis were exposed but no abscess was found. The obturator membrane was then opened and the inner surfaces were explored. Multiple drill holes were made in the region of the superior ramus of the ischium which showed changes in the roentgenogram. No gross pus was seen but an iodoform gauze drain was inserted. The toxemia subsided promptly and the temperature became normal within a week. The drain was removed after a few days and the patient was able to move the hip for the first time without pain. At the end of 14 days he was sent home with no complaints.

The patient re-entered the hospital 2 months later complaining of difficulty in using the left leg in walking. There was no pain at this time. He stated that shortly after returning home he had developed a severe pain in the left hip radiating to the knee. This lasted several days but gradually improved without treatment. Since then he has been unable to straighten the thigh at the hip and walking has become difficult.

Examination at this time showed the left thigh flexed to an angle of about 45 degrees and slightly abducted. The hip joint seemed firmly fixed but there was no pain or tenderness. The muscles of the left thigh and leg were moderately atrophied from disuse. The knee was normal. At this time a large amount of free pus was expressed from the right tonsil which was larger than the left and slightly reddened. There were no complaints of sore throat.

Roentgenograms showed an extension of the destructive process previously seen in the ramus of the ischium into the acetabulum and the head of the femur. The joint space was almost completely obliterated due evidently to destruction of the joint cartilage. There was no evidence of bony fusion.

The patient was anesthetized and considerable force was necessary to correct the flexion deformity of the hip. A plaster-of-paris cast was applied to the body and leg and was worn for 2 months. After removal of the cast walking was much improved. No symptoms of inflammation followed the manipulation or occurred during the subsequent 3 months.

**CASE 3** Acute osteomyelitis of the superior ramus of the ischium with abscess. Chronic abscess in the thorax. Female, age 44 years. The illness began about 3 months previously following a cold. It started with vague pains in the chest a fever and a persistent cough. There was no sputum and no history of previous symptoms. The family history was negative for tuberculosis. The past history was negative except for a fall one year ago with a fracture of the necks of both femurs. Since then she has walked with crutches.

During the past month the patient has become toxic and mentally sluggish. A swelling suddenly appeared over the ischium and there was an increase in fever and toxemia. The white blood count was 35,000. The swelling was incised near the tuberosity and a large amount of pus was evacuated. A roentgenogram was taken about a week later and showed a sharply demarcated area of bone destruction in the superior ramus of the ischium near the greater tuberosity with no evidence of new bone formation (Fig. 3). There was dullness beneath the right scapula. A roentgenogram of the chest showed on the right side a walled off pulmonary abscess. It was thought was not to explore this abscess at that time due to her poor condition. The Wassermann and the urine analyses were negative. The large deep wound over the ischium drained well. Death which occurred 2 or 3 weeks later while the patient was still in a septic condition.

**CASE 4** Acute osteomyelitis of the neck of the right femur. Chronic osteomyelitis of nine years duration with sequestrum of the inferior ramus of the left ischium. Multiple old healed areas of osteomyelitis.

J. H., male aged 17 years came into the hospital with a high fever, toxemia and symptoms of an acute osteomyelitis of the neck of the femur which I operated upon and drained. This was followed by a long convalescence.

There was a history of multiple osteomyelitis 9 years previously. At that time throughout a year he had multiple foci involving the hands, arms, ribs, legs and the right hip with abscess formation. In one of these attacks an abscess ruptured on the right side of the perineum and except for occasional temporary closing he has had a sinus there ever since. Roentgenograms taken of the pelvis at this examination (Fig. 4) showed a chronic osteomyelitis of the left ischium in the region of a small external sinus which was draining pus. A phenol area of dense bone resembling a sequestrum was noted in the inferior ramus of the ischium with a narrowed ring of lessened density resembling a bone cavity around it. Several somewhat irregular areas of new bone formation were seen along the borders of the ischium. The head of the femur on this side presented a mushroom like appearance with considerable bone hypertrophy and proliferation at its base. There were no previous symptoms or history of involvement of this left hip during the attacks of osteomyelitis. The changes were possibly secondary to the extension of the infection years ago from the osteomyelitis of the ramus of the ischium. There was evident tilting downward of the pelvis on the right side but no x-ray evidence of the acute osteomyelitis of the neck of the femur.

Nothing was done at this time to relieve the chronic osteomyelitis of the ischium because of the acute process in the neck of the right femur which was operated upon.

#### ETIOLOGY

Hæmatogenous osteomyelitis of either the pubis or the ischium is relatively infrequent as compared with the occurrence of the condition in the ilium or the long bones. Klemm noted involve-



Fig. 1 Roentgenogram of Case 1 before operation. Areas of rarefaction and increased density were present in both rami of the ischium and in the inferior ramus of the pubis with some proliferative changes.

The increased density of the right obturator foramen was due to an abscess.

the localization of the infection is usually in the metaphysis and that it spreads subperiosteally. This method may be effective early and is less serious than more destructive procedures. Even though a small focus is not directly tapped, the drill holes in the cortex offer relief of tension and may prevent massive bone necrosis. Platt prefers a small trephine opening for early drainage.

In doubtful cases there is little risk in early exploratory operation or even drainage under good conditions before changes may be detected by the roentgen ray. This makes it important to know the usual location of osteomyelitis of the ischium and pubis.

In the fulminating types or during an acute toxemia with a generalized infection general supporting measures are indicated and delay in operation may be advisable.

The application of a plaster of paris cast completely limiting all motion has been emphasized by Orr in the treatment of osteomyelitis. I believe that this should be done especially if the osteomyelitis of the ischium or pubis approaches the joint. Weight extension with suspension of the limb may be useful in early cases.

Stern has found immobilization useful in the treatment of acute non suppurative ankylosing arthritis of the hip associated with destruction of the articular cartilage and obliteration of the joint space. Similar joint changes developed in Case 2. In this instance a flexion deformity of several weeks duration was largely corrected under an anesthetic with improvement following the application of a cast.



Fig. 2 Roentgenogram of Case 2 before operation. Areas of rarefaction were present in the inferior ramus of the left ischium with a zone of new bone formation externally. The hip joint was normal at that time.

Raeschke saucerized a small cavity filled with granulation tissue in the inferior ramus of the pubis and the patient recovered.

Operative exposure of both the pubis and ischium is desirable because drainage should be established before roentgenological changes occur. An abscess will usually be directed to the space beneath the external obturator muscle beneath the internal obturator or into the ischiorectal fossa. A posterior surgical approach to the ischium either from within or without offers insurmountable objections. An approach between the tuberosity of the ischium and the hip joint may endanger the sciatic nerve with its branches and the numerous short muscles to the femur. The thick gluteus maximus would also make it more difficult. Occasionally, an abscess may point posteriorly and an exploratory aspiration or simple drainage may be accomplished by this route.

A surgical approach to the ischium through the ischiorectal fossa is objectionable because of the presence of the fibrous sheath forming Alcock's canal the contents of which, the internal pubic nerve and artery, extend from behind the spine of the ischium forward on the medial surface of the tuberosity and then along the inferior ramus of the ischium. In Case 4 an abscess pointed in the ischiorectal fossa and was incised.

aggravation of a toxæmia resulting from an abscess in the chest

The course was subacute in Case 1 with repeated acute exacerbations of pain and disability lasting for a few days and gradually becoming worse. In Case 2 acute symptoms recurred, following an attempt to walk after a quiescent period of 3 weeks, and the infection extended to the hip joint.

The local symptoms during the acute period were pain, deformity, muscle spasm, swelling, and tenderness anterior and medial to the hip. Pain was complained of in the region of the hip in acute attacks and in one patient referred along the thigh to the knee. Movement was limited in all directions by muscle spasm, and pain was felt on any movement in all acute cases, especially when the leg was extended.

Swelling was observed only with an abscess.

Local tenderness was always present medially in the thigh over the ramus involved. Some tenderness was also present anteriorly over the hip. Pelvic tenderness may be determined by rectal examination. In Case 2, abdominal tenderness was present in the region of the iliopsoas muscle. No tenderness was felt on pressure over the neck of the femur posteriorly or over the great trochanter.

There was flexion deformity of the thigh to about 40 degrees in the acute cases. If an attempt was made to extend the thigh when the patient lay upon his back a definite downward tilting of that side of the pelvis was produced. This was evident in the roentgenograms, the shadows of the rami of the pubis and ischium overlapping on the affected side so that it was necessary to retake the picture with the X-ray tube farther down in order to show the obturator foramen and the ramus. This tilting of the pelvis was also present in Case 4 on the side opposite the chronic osteomyelitis of the ischium and was caused by the acute osteomyelitis of the neck of the femur.

The increased density in the obturator foramen on the side of the osteomyelitis in Case 1 was due to an abscess (Fig. 1).

The earliest roentgenogram was taken 12 days following the onset in Case 2 and several weeks after the onset in Case 1.

An abscess arising from an osteomyelitis of the pubis or ischium and pointing in the region of the ischio-rectal fossa may be mistaken for a rectal abscess or a cold abscess arising from the pelvic bones. A chronic osteomyelitis may be diagnosed by means of a roentgenogram and if necessary, by the injection of the sinus.

Acute inflammatory rheumatism is usually associated with multiple involvement, swelling, greater tenderness, and muscle spasm. Early acute osteomyelitis of the neck of the femur may have similar constitutional symptoms, but the deep tenderness posteriorly over the neck of the femur is characteristic and early muscle spasm and pain on movement are not so marked. With a suppurative arthritis, the local symptoms and swelling usually predominate. Ræschke, however, did an exploratory aspiration of the hip in his case of osteomyelitis of the pubis.

#### PROGNOSIS

The mortality rate in osteomyelitis of the pubis and ischium is difficult to determine from a small series of cases. In 10 cases including the 4 reported by the author, 1 reported by Ræschke, 3 by Doran and Brown, and 2 by Lloyd, only 1 died, a mortality of 10 per cent. However, 4 of these were seen when chronic and the outcome is not known.

The mortality rate is high in acute haematogenous osteomyelitis of all bones. Doran and Brown reported 8 deaths in 42 cases or 19 per cent. Ogilvie reported 11 deaths in 51 cases or 21 per cent, but a mortality of 33 per cent in the cases of osteomyelitis of the ilium. Platt stated that the mortality of osteomyelitis of the flat bones, especially the ilium is very high but this is due to the fact that the infection here is very severe.

Lloyd stated that there was a higher mortality from the staphylococcus aureus than from the staphylococcus albus, the streptococcus or the pneumococcus. It would seem that the mortality from osteomyelitis of the pubis and ischium is lower than in other bones and considerably less than that of the ilium.

After drainage of the abscess in Case 1 the inflammatory symptoms subsided, and perfect function of the hip and thigh promptly resulted. Healing of the sinus occurred after 5 months. Inflammation extended to the hip joint in Case 1 and old changes were evident in Case 4. Case 3 with a pulmonary abscess developed toxæmia, osteomyelitis and died. Case 4, with chronic osteomyelitis of the ischium of 8 years duration developed an acute osteomyelitis of the right femur.

#### TREATMENT

Early operation with drainage is essential in osteomyelitis of the ischium and pubis. The treatment of suppurative osteomyelitis by subperiosteal incisions and multiple drill holes as advocated by Starr is based upon the fact that

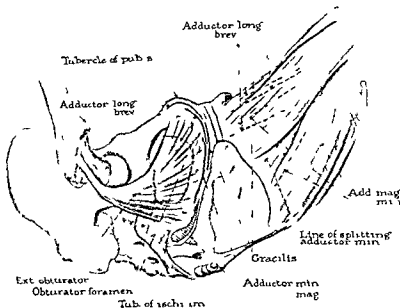


Fig. 5 Drawing made from dissections on the cadaver in the lithotomy position showing the origin and the relation of the adductor muscles

The external boundary of the obturator fossa is formed by the external obturator muscle the fascial origin of which extends well out on the ramus and almost to the pubic tubercle. There is a large potential space the boundaries of which would be medially a large part of the adductor group of muscles anteriorly the pectineus posteriorly the quadratus femoris while the base would be formed by the external obturator muscle. An abscess in this space might point anteriorly along the insertion of the iliopsoas muscle

medially through the adductors or posteriorly, into the ischiorectal fossa.

The obturator fossa contains some fat and is largely external to the foramen. However, the space also extends within the obturator foramen to surround a considerable part of the inner surfaces of both rami of the pubis and ischium. This inward extension of the fossa is the result of the origin of the obturator membrane from the inner surfaces of the rami some distance back from the margins of the obturator foramen especially below

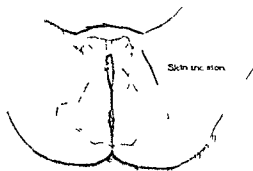


Fig. 6A Drawing to illustrate the incision which is made in original method of operation upon either the pubis or ischium

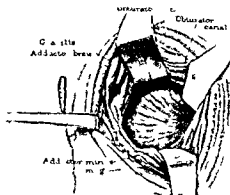


Fig. 6B Splitting the adductor minimus muscle provides a satisfactory approach. The external obturator muscle may then be split to expose the pubis or ischium



Fig 3 Roentgenogram of Case 3. A sharply outlined area of bone destruction is shown near the tuberosity of the ischium.

A perineal approach with exposure of the inner side of the inferior ramus of the pubis through the urogenital structures with their blood vessels and nerves is practically impossible. An anterior approach through the groin to the superior ramus of the pubis would be unsatisfactory because it would expose only a small area and might also endanger important fascial structures about inguinal canal or blood vessels and nerves to the thigh.

Any of these routes of surgical approach to the pubis and ischium would result in a difficult and dangerous operation with a limited exposure of the rami and would offer no chance for exploration or drainage of the bodies of these bones.

A satisfactory method of approach through the split adductor muscles was originated after a study of the surgical anatomy on the cadaver (Fig 5) and was used in Cases 1 and 2.

#### SURGICAL ANATOMY

The adductor longus tendon arises from the ramus of the pubis just below and medial to the tubercle, and the muscle broadens out to extend laterally and toward the shaft of the femur.

The adductor brevis arises beneath the longus and the gracilis with the lower end arising between



Fig 4 Roentgenogram of chronic osteomyelitis of the inferior ramus of the ischium. A phlebotic dense shadow resembling a sequestrum was surrounded by a cavity. Of hypertrophic changes are seen in the head of the femur.

the gracilis and the adductor minimus. The two edges of the brevis parallel rather closely the upper and lower borders of the symphysis pubis. The adductor brevis then spreads out in a broad thick band extending a little below the adductor longus but is completely covered by the gracilis muscle.

The adductor minimus has a longer origin than the other adductors but is somewhat thinner. Its anterior edge arises from beneath the border of the brevis and the middle of the gracilis and its posterior edge beneath the adductor magnus not far from the tuberosity. The muscle belly passes rather suddenly underneath the adductor brevis and the magnus due to the rapid convergence of these muscles.

The adductor magnus muscle has a broad attachment to the ischium, which extends from the region of the tuberosity to occupy two thirds of the distance to the gracilis and overlaps the adductor minimus.

The fascial origin of the adductor muscles is chiefly along a bony ridge from near the tubercle of the pubis to the tuberosity of the ischium. The ridge forms about one third of the outer surface of the intervening rami where it stops abruptly in a sharp crest which forms the origin of the strong external obturator fascia. The remaining two thirds of the outer surfaces of these rami are largely covered by the external obturator muscle fibers which are loosely attached to the bone.





and posteriorly. Since the majority of the ramus of the pubis and ischium is surrounded by the obturator fossa, an osteomyelitis would usually form an abscess here. Drainage may easily be obtained through the adductor route of operation.

The internal pelvic space is beneath the dense obturator membrane within the pelvis and is covered largely by the internal obturator muscle and its fascia. An abscess forming here would probably follow down along the rectum. Access to this space may also be obtained through the adductor route of approach. After the obturator fossa is entered the obturator membrane is split and one may then explore practically all of the inner surfaces of the ramus and bodies of the pubis or ischium and if necessary, provide drainage.

The obturator nerve and blood vessels pass out through the obturator canal in the uppermost distal part of the foramen, which will usually permit them to be avoided.

The surgical approach through the medial side of the thigh by splitting the adductor muscles is satisfactory. This opens up a large anatomical space permitting exposure and drainage of practically all parts of both the pubis and ischium.

#### TECHNIQUE OF OPERATION

The patient is placed in the lithotomy position (Fig. 6A). The gracilis muscle may be seen to form a taut broad band along the anterior border of the medial side of the thigh while the adductor magnus muscle forms a band along the posterior border. The pubic tubercle and the tuberosity of the ischium are noted and an imaginary line between them may be seen to pass slightly below the origin of the adductor muscles of the thigh.

A transverse incision is made through the skin in the thigh along this line, extending from the middle of the gracilis to the middle of the adductor magnus muscle. The location of the skin incision some distance from the perineum helps to avoid contamination and also permits wider retraction of the gracilis and of the adductor muscles.

The broad but rather thin belly of the adductor minimus muscle should be split at about the middle of the distance between the gracilis and adductor magnus muscles (Fig. 5). This gives entrance to a large anatomical space with the

external obturator muscle as its base (Fig. 6B). In order to obtain better exposure one may push aside or cut a part of the adductor minimus origin. A part of the gracilis and adductor magnus muscles might also be cut, but it has not been found necessary.

By the splitting of the external obturator fascia and muscle fibers which cover a large part of the ramus of the pubis and ischium the obturator fossa may be entered and the two bones examined or operated upon. If desired the obturator membrane may be incised and the interior surfaces explored.

Perforation of an osteomyelitis may occasionally occur along the edges of the ramus and cause an abscess pointing in the perineum, the groin or the ischio-rectal fossa. Exploratory aspiration may be done followed by an incision over the point of the greatest swelling.

#### SUMMARY

1. Fairly characteristic symptoms and pathological changes are present in osteomyelitis of the pubis and ischium.
2. A knowledge of surgical anatomy in this region is important.
3. An original operative technique is described, which has proved satisfactory upon both the os pubis and ischium.

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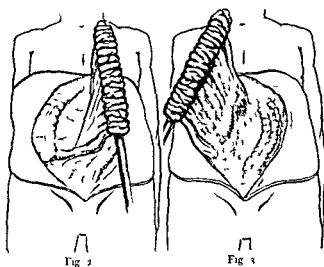


Fig 2

Fig 3

Fig 2 The right fossa of abdominal cavity and oblique attachment of mesentery (Drawn from a photograph)

Fig 3 The left fossa of abdominal cavity and oblique attachment of mesentery (Drawn from a photograph)

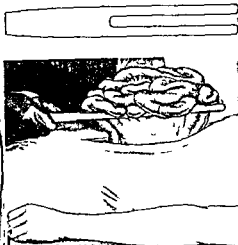


Fig 4

Fig 4 The elevation of all the coils of the small intestine upon an instrument especially designed for this purpose

to occupy a space of not much more than one foot in length (Fig 1).<sup>1</sup>

When the intestine, held in this manner upon a rod is so placed that the axis of the rod is parallel with the oblique axis of the mesenteric root the entire mesentery may be inspected with great ease. Looked at in this way, it forms a sort of partition as it were with the puckered intestine fringing its upper edge. It thus divides the abdominal cavity into two large fossae of which the left is much the larger. By moving the rod toward the left side of the abdominal cavity the right fossa of the abdomen may be demonstrated (Fig 2) and by moving it to the right side the left fossa is brought into view (Fig 3). In spite of the various curves folds and twists which affect the shape of the intestine and its mesentery when under normal conditions they lie within the abdominal cavity the mesenteric partition between the two abdominal fossae must still to a certain extent continue to exist and to some slight degree must separate the two sides of the abdominal cavity a circumstance which certainly should be borne in mind in case any attempt is made to cleanse the peritoneal cavity by flushing. It is I think a point worth noting that in case we have to wash out the abdominal cavity the mesentery on the two sides of any loop of small intestine will conduct the tip of the irrigating tube to the bottom of the two fossae. We can thus at once flush

out the great right and left cavities from the bottom in a manner which must certainly be an improvement over the old custom of pushing the irrigating tube aimlessly into different parts of the abdominal cavity.

The correspondence between the different parts of the small intestine and the deep attachment of the mesentery is made evident here (Figs 1, 2, and 3), and it becomes more obvious why the upper part of the intestine would be most apt to occupy the upper part of the abdomen and the lower part of the intestine the lower part.

A demonstration somewhat similar to the above may be made in the following manner: the intestine is gathered upon a large fork shaped instrument, between the prongs of which the mesentery is drawn. This method of demonstration has the advantage of not requiring an opening into the lumen of the gut (Fig 4).

Or still again a very effective way of displaying the whole intestine and its mesentery at the same time is to suspend the intestine as before except that it is held in place by means of stout copper wire which has been introduced into the gut and is then bent in such manner (first to one side and then to the other) that it throws the gut itself into a long series of alternating loops. When thus arranged the intestine is exposed for its entire length and the mesentery with its ruffled border is spread out so that the whole extent of its two surfaces can at once be inspected with ease (Fig 5).

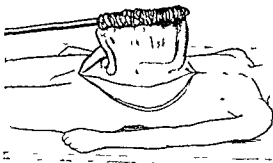


Fig. 1. The small intestine is puckered upon a rod. It is surprising with what ease this can be accomplished. The rod cannot be pushed into the bowel, but the bowel can be drawn loop by loop over the end of the rod and puckered upon it so that the various loops become packed together. In some later experiments occasionally a tube was used instead of a rod. (Drawn from a photograph.)

#### TESTS AS TO POSITION

Many tests were made through a number of differently placed abdominal incisions in 16 cadavers. Through each wound one or more intestinal loops was pulled out and the characteristics were noted. They were then tagged and dropped back into the abdominal cavity. On each tag was recorded the estimated distance downward from the duodenum (or upward from the ileocecal valve) that is its supposed position. Incidentally, in many cases opinion as to the direction of the loop was also recorded by a safety pin fastened to the wall of the gut, the point of the pin indicating the supposed direction toward the ileocecal valve.

Later, the abdominal cavity was laid open from the ensiform cartilage to the symphysis pubis, and the actual distances of the different tags from the end of the duodenum (or from the ileocecal valve, as it might be) determined by measurement and a record, registering the exact amount of error as to position was at once made. Record was also made as to the correctness or incorrectness of the supposed direction.

One hundred and eighty different localizations as to position were made in all. These localizations, however, were made on only about 125 different loops as my assistant and myself frequently localized the same loop, independently of each other, such localizations on the same loop being recorded as 2. According to the tables prepared at that time about 75 per cent of all localizations as to position were made with errors of less than 3 feet, the average error in the 180 tests being a little over 2 feet. Actual measure-

ments, that is, the actual distances from the end of the duodenum (or from the ileocecal valve) to the various loops under consideration were used for record in these tests, as being best adapted for the purpose of comparing results. Although, in practical work, it would probably be sufficiently accurate to speak of a loop as being let us say in a stated part of the upper, middle or lower thirds of the intestine.

#### TESTS AS TO DIRECTION

Tests to determine the direction of the intestine were made on 90 intestinal loops in 15 different cadavers. In 82 (or 91 per cent) the estimated direction proved to be correct, in 8 it was incorrect. It is only fair to say that the errors both as to position and direction were more frequent in the early tests than in the later ones.

Although all these studies were made upon the cadaver the correctness of many of the observations recorded at that time was by chance later confirmed on the living subject.

#### THE SMALL INTESTINE AND ITS MESENTERY AS A WHOLE

Before going into details concerning the different characteristics of the jejunum-ileum and its mesentery, it would seem best to demonstrate these structures as a whole in such manner that one can best appreciate their general shape and their relations to one another and to the posterior wall of the abdominal cavity in which they lie and from which the root of the mesentery arises.

It has always seemed to me that the most effective way in which to make such a demonstration is to suspend the entire small intestine with its attached mesentery, well above the abdominal cavity, thus temporarily emptying that cavity so far, at least as the small intestine and its mesentery are concerned. This can be accomplished on the cadaver (after the omentum has been raised up) in a number of different ways, the first of which being that shown in Figure 1, in which the whole of the small intestine (gathered upon a rod or dowel and elevated well above the abdominal cavity and carrying with it the attached mesentery) is made to conform to a straight line. The rod has been introduced into the gut through a small opening about 6 to 8 inches above the ileocecal valve and the entire small intestine barring the upper and lower few inches is drawn over its tip and puckered upon the rod. Two temporary ligatures are then placed on the ends and it is found that without using undue force the 21 feet of intestine more or less can be made

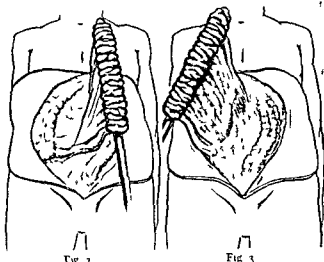


Fig 2

Fig 3

Fig 2 The right fossa of abdominal cavity and oblique attachment of mesentery. (Drawn from a photograph)

Fig 3 The left fossa of abdominal cavity and oblique attachment of mesentery. (Drawn from a photograph)



Fig 4

Fig 4 The elevation of all the coils of the small intestine upon an instrument especially designed for this purpose

to occupy a space of not much more than one foot in length (Fig 1)<sup>1</sup>

When the intestine held in this manner upon a rod is so placed that the axis of the rod is parallel with the oblique axis of the mesenteric root the entire mesentery may be inspected with great ease. Looked at in this way it forms a sort of partition as it were with the puckered intestine fringing its upper edge. It thus divides the abdominal cavity into two large fossae of which the left is much the larger. By moving the rod toward the left side of the abdominal cavity the right fossa of the abdomen may be demonstrated (Fig 2) and by moving it to the right side the left fossa is brought into view (Fig 3). In spite of the various curves folds and twists which affect the shape of the intestine and its mesentery when under normal conditions they lie within the abdominal cavity the mesenteric partition between the two abdominal fossae must still to a certain extent continue to exist and to some slight degree must separate the two sides of the abdominal cavity a circumstance which certainly should be borne in mind in case any attempt is made to cleanse the peritoneal cavity by flushing. It is, I think, a point worth noting that in case we have to wash out the abdominal cavity the mesentery on the two sides of any loop of small intestine will conduct the tip of the irrigating tube to the bottom of the two fossae. We can thus at once flush

out the great right and left cavities from the bottom in a manner which must certainly be an improvement over the old custom of pushing the irrigating tube aimlessly into different parts of the abdominal cavity.

The correspondence between the different parts of the small intestine and the deep attachment of the mesentery is made evident here (Figs 1, 2, and 3), and it becomes more obvious why the upper part of the intestine would be most apt to occupy the upper part of the abdomen and the lower part of the intestine the lower part.

A demonstration somewhat similar to the above may be made in the following manner: the intestine is gathered upon a large fork shaped instrument, between the prongs of which the mesentery is drawn. This method of demonstration has the advantage of not requiring an opening into the lumen of the gut (Fig 4).

Or still again, a very effective way of displaying the whole intestine and its mesentery at the same time is to suspend the intestine as before except that it is held in place by means of stout copper wire which has been introduced into the gut and is then bent in such manner (first to one side and then to the other) that it throws the gut itself into a long series of alternating loops. When thus arranged the intestine is exposed for its entire length and the mesentery with its ruffled border is spread out so that the whole extent of its two surfaces can at once be inspected with ease (Fig 5).



Fig 5 The intestinal tube has been thrown into alternate curves which are held in place by means of a stout copper wire within the gut. The alternating arrangement of the loops is most evident near the lower end of the ileum. The mesentery is flat up to the place where the ruffled edge begins. (Drawn with slight modifications from a photograph.)

*The mesentery.* As it is naturally desirable that one should be familiar with the characteristics of the mesentery, it is perhaps well to review certain facts about it. The translucency of the mesentery varies enormously and is largely dependent on the absence of fat, the less fat the greater the translucency. As a rule there is less fat in those parts of the mesentery opposite the upper portions of the intestine than there is in those parts opposite the lower portion of the intestine, where the mesentery may be wholly opaque.

That part of the mesentery where the vessels enter is, as pointed out by Treves, the real root of the mesentery, but as the mesentery itself is attached to the back part of the abdominal cavity for about 6 inches below that point the root of the mesentery is usually considered to include this 6 inches of attachment. This root lies obliquely in reference to the spine and it can be roughly marked out on the abdominal wall (Fig 6).

Though the root of the mesentery measures only about 6 inches, the intestinal border of this structure may measure from thirty to fifty times as much or even more. This of course means an enormous expansion, one which however is greatest in the outer third or fourth of the mesentery. It is this greatly elongated outer or "ruffled" border that the surgeon has to deal with most often.

It is obvious that such a structure as the mesentery, in order that it may be accommodated in the abdominal cavity must be thrown into many folds, folds which are even more numerous in cases in which the length of the intestine which averages about 21 feet is greater than usual. These folds are naturally simplest near the

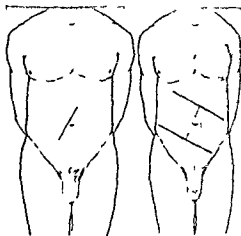


Fig 6 left Showing approximately the line of the mesenteric root as traced on the abdominal wall.

Fig 7 Two oblique lines (black) have been drawn at right angles to the two ends of the line (dotted) of the mesenteric root. The upper middle and lower compartments here indicated contain in most instances the upper middle and lower thirds of the small intestine respectively.

root of the mesentery, where the diameter of that structure from above downward is comparatively little increased. Of these main folds, the first one arising from the upper part of the mesenteric root is usually directed to the left side of the abdomen, the next one to the right, while those arising below proceed somewhat indefinitely from the lower part of the mesenteric attachment to both sides of the abdomen and the pelvis.

#### MEANS AVAILABLE FOR LOCALIZING A LOOP OF INTESTINE AS TO POSITION

In order properly to localize a loop of intestine which presents itself in an abdominal wound, one should be familiar with the following: (1) the part of the intestine most likely to be encountered in wounds in the different parts of the abdominal wall, (2) the general characteristics of the intestine in the different parts of its course, together with the characteristics of the attached portions of the mesentery.

*The part of the intestine most likely to be encountered through wounds in different parts of the abdominal wall.* In a general way it may be said that the uppermost third of the intestine usually occupies the large cavity on the left side of the abdomen, high up underneath the ribs, the middle third occupies the middle part of the abdomen and the left iliac fossa, and the lowest third helps to fill the pelvis and the right iliac fossa.<sup>1</sup>

<sup>1</sup>This duplication of the various parts of the intestinal tube agrees, in general, with that spoken of by Mall as the "normal arrangement."

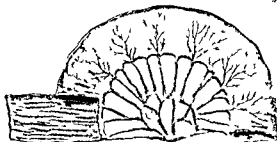


Fig 8 A loop with attached mesentery from the small intestine of a thin muscular (male) subject. It belongs to the uppermost part of the bowel as is shown by its large size, its obvious thickness, its vascularity, and by the presence of large and numerous valvulae conniventes (a segment of the intestine being opened up to display them) and also because of the presence of large long and straight vessels in the mesentery radiating to the gut from arches mostly primary. There is very little fat in the mesentery and the transparent spaces between the vessels are very extensive.

Occasionally a loop from the lowest part of the intestine may be found high up in the abdomen, but this is unusual, and it is perhaps even more unusual for a loop from the highest part of the intestine to lie near the pelves.

The 3 compartments which the different thirds of the intestine (from above downward) usually occupy can roughly be outlined on the surface of the abdomen by means of two lines which are drawn at the two extremities of the oblique dotted line (representing the mesenteric root) and at right angles to it (Fig 7). The surgeon may, therefore, knowing what compartment his incision has opened up, roughly determine what part of the intestine he is most likely to encounter.

The general characteristics of the intestine in the different parts of its course together with those of the attached portions of the mesentery. If one examines the entire length of the bowel (and its attached mesentery) one finds that many of the characteristics of the loops belonging near its upper end vary considerably from those of the loops near its lower end, but one also notices that these changes take place in the course of the tube not abruptly but gradually, and further that this gradual change applies equally to the characteristics of the attached mesentery. The contrast between the characteristics of the upper part of the intestine and its lower part are generally more marked in the male than in the female.

If the surgeon examines a loop of small intestine which belongs in the uppermost part of the bowel (Fig 8) he will probably notice that it is of large caliber and thick or even fleshy. If he holds it now between the thumb and fingers of one

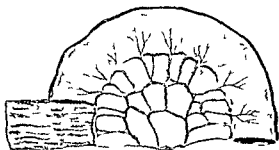


Fig 9 A second loop with attached mesentery from the same intestine as that from which the loop shown in Figure 8 was taken. It belongs however to the lowest part of the bowel as is shown by its smaller caliber, its comparative thinness, the absence of vascularity and of valvulae conniventes, and also by the presence in the mesentery of comparatively short, small and somewhat tortuous vessels which radiate from arches mostly secondary or tertiary. The fat in the mesentery is more abundant than in the specimen shown in Figure 8, and it approaches nearer to the intestine. For this reason the mesentery here is much more opaque, the vessels are somewhat obscured, and the transparent areas small.

hand, and, stroking it gently downward in the direction of its axis between the thumb and fingers of the other, he will distinctly feel the valvulae conniventes as his fingers pass over them. He will probably notice also that the intestine is very vascular, being covered with numerous branching vessels. Indeed, everything about the loop will probably suggest to him a high degree of physiological activity of this part of the bowel.

The amount of information which the surgeon will get by an examination of the attached mesentery depends largely on the amount of fat there. If, as one would expect in a thin subject, there is little fat in the mesentery, he will be able to see the blood vessels to note their characteristics, and thus to get considerable information as to the part of the mesentery he is examining; but if there is so much fat as to conceal the vessels entirely, he will, for localization purposes at least, not secure very much information. Luckily, however, the fat opposite the upper part of the bowel is not often present to such a degree as entirely to conceal the vessels, and they—at least that part of them nearest to the intestine—are usually fairly well defined. In a case then in which the vessels are visible, the surgeon will

Diagrammatically speaking, the main branches of the superior mesenteric artery are with each other by means of a series of arches the convex side of which face the intestine. These arches originate at the upper end of the bowel, the most primary, but upon these as one proceeds down the mesentery, parallel with the intestine, are secondary ones. From these arches, the vessels radiate to the intestine, upon which they ramify alternating as a rule from one side of it to the other. The arrangement of the mesenteric vein is somewhat similar to that of the arteries.

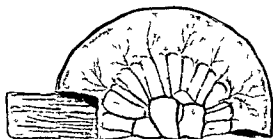


Fig 10 A loop with attached mesentery from the small intestine of a female subject which had less muscle and more fat than the subject which furnished the specimen in Figures 8 and 9. This loop belongs to the uppermost part of the bowel as is shown by its large size its comparative thickness its vascularity and the presence of large and numerous valvulae conniventes also by the large long and straight vessels in the mesentery which vessels radiate to the gut from arches mostly primary. There is a good deal of fat in the mesentery and because of this the vessels are somewhat obscured and the transparent areas near the intestine are very small.

probably notice at once that these vessels are large long and straight and that they radiate from the depths of the mesentery directly to the intestine. He will probably also be able to see, especially if he retracts the edge of the wound that these vessels arise mostly from the primary arches, deep in the mesentery. A few secondary arches may be seen but these are usually more characteristic of the mesentery opposite lower parts of the intestine. The parts of the mesentery between the vessels will probably be more or less translucent, or when near the intestine even transparent. These transparent spaces between the vessels appear like little windows as it were through which one may look because of their shape and transparency I have called them 'lunettes'.



Fig 11 A loop with attached mesentery from the small intestine of the same subject as the loop in Figure 10. It belongs to the lowest part of the bowel, as is shown by its thinness its small caliber the absence of vascularity and of the valvulae conniventes also by the fact that the vessels in the mesentery are hidden in a thick layer of fat. Little tabs of fat encroach upon the wall of the intestine itself.

In a loop of bowel from the lowest third of the intestine the surgeon sees a different picture (Fig 9). This loop of bowel is usually though not always thin and has generally a somewhat smaller caliber than a loop from the uppermost part of the bowel. Few valvulae conniventes can be felt through its walls, or even none at all. Finally, it is probably less vascular than is the loop higher up in the bowel.

The vessels of the mesentery, if they can be seen at all through the fat, are noticed to be comparatively short, small and often more or less tortuous in their course. If the edge of the abdominal wound is strongly retracted these may be seen to arise from secondary, or even tertiary, arches. Everything in fact, will probably suggest to him a low degree of physiological activity which possibly explains why such great lengths of this part of the intestine may be excised without seriously interfering with the nutrition of the patient. Excision of only a few feet of the upper part of the jejunum would probably result in death.

There is almost always more fat in this part of the mesentery than there is in that part of it attached to the upper portions of the bowel. For this reason the mesentery here is much more opaque. Moreover the fat usually reaches nearer to the intestine, a common characteristic of this part of the mesentery being that little tabs of fat project from it upon the bowel itself (Fig 11) a condition rarely found in the mesentery opposite the upper part of the intestine, except in subjects with an unusual amount of fat.

The increased thickness of the lower part of the mesentery is not only due to the disposition of fat but also to the presence of larger and more muscular tissue which is said to add to the support of the lower coils of the intestine.

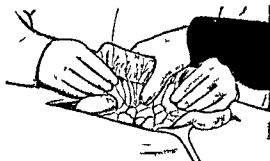


Fig 12 A method of determining the real direction of the intestine by palpation of the mesentery.

Figures 10 and 11 show two loops of intestine from a somewhat adipose female subject. The first loop is from the uppermost third of the intestine and the second one from the lowest third. The excess of fat in the first specimen somewhat obscures the mesenteric vessels and in the second specimen practically hides them.

It is for the surgeon then, when he examines a loop of bowel and its mesentery, to determine its approximate position by roughly estimating in his mind the stage of the transition (in the characteristics referred to) which the loop of bowel and its attached mesentery suggests; this estimate being strengthened or modified by the knowledge as to the part of the abdominal cavity in which the loop has been found.

The thicker, the larger, the more vascular the loop of bowel, the more distinctly the valvulae conniventes can be felt through its walls and in the mesentery—in case the amount of fat does not conceal them—the larger the longer the straighter the blood vessels arising as they do, from primary arches and the greater the transparency of the mesentery (or, at least its translucency) the more probable it is that the loop in question belongs to the upper part of the bowel.

On the other hand, the thinner, the smaller, the less vascular the loop, the less distinctly the valvulae conniventes can be felt through its walls and in the mesentery—in case the amount of fat does not conceal them—the smaller, the shorter, the more tortuous the mesenteric vessels, the more they appear to rise from secondary, or even tertiary arches, the thicker and more opaque the mesentery itself, especially if tabs of fat project from it upon the bowel—the more likely it is that the loop belongs to the lower part of the bowel.

It is not by any one of these signs, but by a combination of them, including of course proper consideration as to the part of the abdomen in which the loop lies—that the surgeon makes his estimate as to the part of the bowel to which the loop belongs. His localization may not be very exact, but, when he needs the information the localization as he has made it is probably better for his purpose than no localization at all.

#### MEANS AVAILABLE FOR DETERMINING THE DIRECTION OF A LOOP OF INTESTINE

To know the real direction of the bowel in any given loop is of course often useful to the surgeon. This can be easily determined by reference to that part of the mesentery which lies between the intestinal loop and the mesenteric root. One procedure is as follows: the loop in question is drawn well out of the wound and its two extremities held upward by an assistant, the axis of the loop being kept parallel to the known axis of the mesenteric root (Fig. 6). The surgeon's right hand is now applied to the loop in such manner that his thumb is on one side of the mesentery and his first two fingers are on the other (Fig. 12).

The thumb and fingers are then gently pushed down toward the root of the mesentery. If, by palpation of the mesentery, the surgeon succeeds in determining that there is no twist in it, he at once knows that the upper end of the loop (as it is then held) will, if followed up, conduct him to the duodenum and the lower end to the ileocecal valve. If however there is a twist in the mesentery, the surgeon should withdraw his hand, remove the twist by turning the loop of bowel and examine again. When finally, no twist remains in the mesentery and the loop of bowel is parallel with the known direction of the mesenteric root, the surgeon knows that the upper end of the loop is nearest to the duodenum and the lower end to the ileocecal valve.<sup>1</sup>

The same determination as to direction may be made by palpation of only one side of the mesentery or even by inspection alone, if the abdominal wall on one side of the wound and the coils of intestine under it are strongly retracted.

So much for the localization of a loop of small intestine as to position and also as to direction. It has certainly been of much use in the past. But—if for no other reason than that the more a surgeon knows the better, concerning the region in which he is operating—a careful consideration of its technique must be worth while.

<sup>1</sup> It was not a little long after I had made these tests that I realized that this method for determining direction by reference to the mesentery had been spoken of before. There is a full account to which I found reference in an article by Mr. R. F. R. d. (Lancet, Dec. 22, 1883, p. 2083).



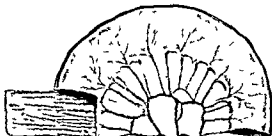


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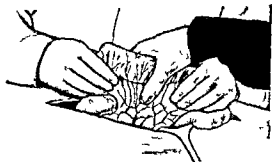


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The increased thickness of the lower part of the mesentery is not only due to the deposits of fat but also to the presence of fibrous and muscular tissue which is said to aid in the support of the lower coils of the intestine.



Fig. 1 Case 1. First X-ray taken during contraction. Dilatation  $3\frac{1}{4}$ -4 fingers. Position left occiput posterior. Clip in anterior lip of cervix.

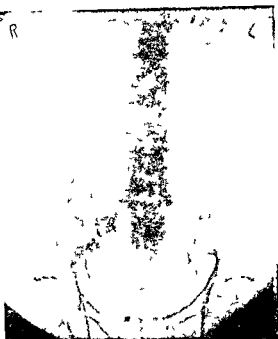


Fig. 2. Second roentgenogram taken during the period of relaxation immediately following the contraction shown in Figure 1.

a well developed, well nourished woman of stated age with clear skin and no enlargements of lymphatics. There was no tenderness on pressure of the sinuses, the movements and reactions of the eyes were normal, ears, nose and mouth were also normal. The thyroid gland presented a slight enlargement. The lungs were clear on inspection.

The X-ray pictures in this article were taken at New Ashbury Hospital, New York.

palpation, percussion and auscultation. The heart was in the usual position, the apex beat which was regular (80 per minute) was in the midclavicular line in the fifth interspace. Blood pressure was 115-70. Percussion of the genito-urinary system elicited no tenderness. The uterus was enlarged with child in the left occipito-anterior position. Rectal and pelvic examinations early in pregnancy showed no obstruction in the birth canal. The pelvic

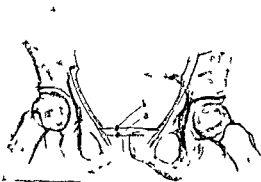
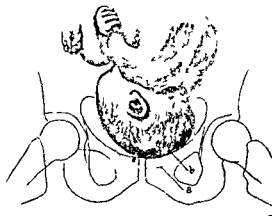


Fig. 3. Comparative drawing. In A the pelvis of the X-ray pictures are overlapped (matched) one on the other. The clips indicate the descent of the uterus in the pelvis during contraction, dotted line *a* with its ascent during relaxation (*b*). In B the clips of the X-ray films are overlapped (matched) one on the other. The relation of the heads of the two X-ray films indicates the motion of



the presenting part within the uterus. Dotted line *a* is the level attained during contraction while the blocked figure *b* indicates the ascent within the uterus during relaxation.

## X-RAY STUDIES ON THE MECHANISM OF LABOR WITH SPECIAL REFERENCE TO PUERPERAL INFECTION

DANIEL H. BESSISTON, M.D. AND ALFRED A. BESSFENSEN, JR., M.D. MINNEAPOLIS, MINNESOTA

THE purpose of this paper is to report clinical X-ray studies concerning the mechanism of labor with reference to puerperal infection. In previous publications puerperal infection has been ascribed to the mechanism of labor as an etiologic factor. Mayes has stated "the advance and regression of the presenting part act similarly to the plunger of a syringe and draw the secretions laden with micro-organisms to the region of the torn and bleeding cervix." Numerous other observers have remarked on the progression and regression of the birth product during labor—especially during the second stage—and have suggested the possible retraction of the cervix. On the other hand certain authors notably Schickele, question the retraction of the lower uterine segment and believe that the cervix dilates only and has no power to contract. Schickele reports as anomalous the cervical contraction which we believe is normal according to this present study.

Some support has been given to the likelihood of the excursion of the presenting part within the uterus by bacterial studies made before, during, and after labor, and the results are especially impressive when compared to the febrile reactions following labor. These studies reported by numerous investigators,<sup>1</sup> indicate that 35 per cent of all women have pathogenic bacteria in the vagina, 20 per cent have streptococci and 4 to 5 per cent have hemolytic streptococci. Of those women with pyogenic bacteria present 4 per cent have fever while 18 per cent of those with streptococci and 75 per cent of those with hemolytic streptococci develop fever. When one totals the number of febrile reactions resulting from all labors, the average is approximately the figures given by these bacteriological studies—7 or 8 per cent—thus giving a very definite relation between vaginal flora and puerperal infection.

Additional support is furnished by bacteriological analyses made during cesarean sections—as reported by Zangemeister and Harns and Brown, to the effect that 6 hours after the start of labor, bacteria are found in the uterus during cesarean section while before the 6 hour period bacteria are not usually present. This shows that the action of labor has some bearing on the presence of bacteria in the uterus.

This present study was undertaken with a view to demonstrating the mechanism of labor and ascertaining if possible the bearing which such mechanism might have on the development of infection during the puerperium.

It was felt that if one could portray the relation between the cervix and the fetal head or presenting part during a contraction, and then again during the immediately following period of relaxation any difference in the measure of distance between the cervix and the crown of the fetal head would represent the excursion of the birth product within the uterus. As such a study in animals would obviously be inconclusive, it must be made on the human subject.

A first effort was undertaken to outline the vagina and the fornices by injection of lipiodol—first applying to the vaginal mucosa an antiseptic X-ray pictures taken under these circumstances show descent of the presenting part into the pelvis during contraction with ascent during relaxation but reveal no outline of the vagina, fornices, or cervix, and thus give no relation between the head and the uterus. In other words they do not show the action within the uterus.

It was then recognized that some metal frame must be attached to the cervix early in labor in order to identify the cervical margin in the X-ray. A skin clip of the Michel variety was used and this was inserted into the vaginal portion of the anterior lip of the cervix when dilatation had approximated 3 centimeters. In 6 of these patients it was impossible to secure the X-ray pictures, either because of the rapidity of labor (5 cases) or the absence of the radiologic technician (1 case). From a study of 12 patients, 6 X-ray pictures were completed clips were used in the cervix in four of these cases and in these cases only is the relation of the presenting part to the cervix shown.

**CASE 1.** Mrs. F. P. A., aged 27 years, primipara, housewife with no worries. Father died of pneumonia, mother, 1 brother and 3 sisters were living and well. Patient had been married 3½ years, her husband was well. Menstruation commenced at 13, recurring every 28 days and lasting 3 to 4 days with no pain and no leucorrhoea. The last period was August 23, 1927. Patient had had measles, mumps, scarlatina, pertussis, chicken pox and influenza. Patient had had some vomiting during the first trimester with tingling of the breasts and slight frequency. She felt life at 4½ months and after that time felt excellent and gained weight normally. Physical examination disclosed

<sup>1</sup> Names indicated in bibliography by asterisk.



Fig. 7. Case 3. First X-ray film taken during contraction. Dilatation complete. Position: right occiput posterior. Clip in anterior lip of cervix.

CASE 2. Mrs. M. C. B., aged 42 years, secundipara, housewife, enjoys life but has financial worries. Father died at 59 of bronchitis, mother 4 brothers and 1 sister were living and well. Patient was married in July prior to appearance; her husband was well. She had had a stillborn boy 5 years previously after difficult labor. Menstruation commenced at 14, recurred regularly every 28 days, the flow lasting 5 days with no pain but with leucorrhoea. The last period had been October 5, 1927. Patient had had measles, scarlatina, pertussis, chicken pox, influenza, and much sore throat with neuritis. She also



Fig. 8. Second picture taken during the immediately following period of relaxation.

had occasional attacks of right maxillary sinusitis and had had appendicitis 5 or 6 years previously without appendectomy.

Patient had had quite distressing nausea and vomiting during the first trimester with some frequency and enlargement of the breasts. She first felt life on December 2, 1924. Physical examination disclosed a well developed fairly well nourished woman of 42 with slightly dark pigmentation of the skin, no enlargements of the lymphatics. Motions and reactions of the eyes were normal; there was no injection of the ears; the nose was clear and free. Teeth were all gone and the tonsils were present though not injected. The neck presented no enlargements. The

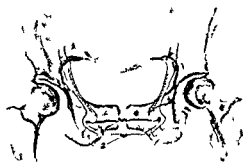
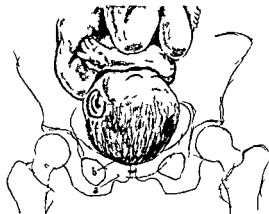


Fig. 9. Comparative drawing. In 1 the pelves are overlapped (matched) one on the other. The clips indicate the descent of the uterus in the pelvis during contraction. Dotted line *a* with its ascent during relaxation. In 2 the clips are overlapped (matched) one on the other. The relation of the heads of the two X-ray films indicates the



motion of the presenting part within the uterus. Dotted line *a* is the level attained during contraction while the blocked figure *b* indicates the ascent within the uterus during relaxation.



Fig 4 Case 2 First X-ray picture taken during contraction Dilatation complete Position middle left anterior Clip in anterior lip of cervix

measurements were as follows interspinous 2, intercrural 32, intertrochanteric 35, bituberous 8, external conjugate 20, internal conjugate 13 with allowances for body thickness 0. The patient was seen only 4 times during pregnancy and each time her blood pressure was below 120 systolic and 70 diastolic with urine showing no albumin sugar or microscopic pathology.

Labor started at 1:00 a.m. June 8, 1928. At 5:00 a.m. effacement was complete with the head above the spines. At 6:00 a.m. an intravaginal mercurochrome preparation was given and a skin clip applied. At 9:45 a.m. there was 1.5 to 2 centimeters of dilatation. At 4:30 p.m. an X-ray picture was taken at 3.5 to 4 centimeters dilatation. The membranes ruptured at 6:35 p.m. and at 6:55 p.m. a female



Fig 5 Second picture was taken during the immediately following period of relaxation

child was delivered with second degree tear. At 1:00 the placenta was delivered complete with single Credé expulsion and a blood loss of 150 cubic centimeters.

First comparative tracing shows descent of uterus into the pelvis 1.5 inch during contraction with ascent during the period of relaxation immediately following.

Second comparative tracing shows a left occipito-anterior cephalic presentation. First picture during contraction shows retraction of the cervix 1.4 inch with its descent in relation to the head during relaxation—an excursion of the presenting part within the uterus of 1.4 inch.

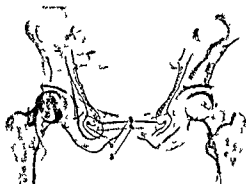
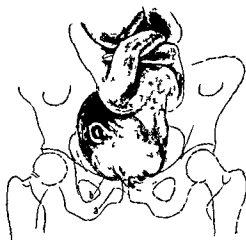


Fig 6 Comparative drawing. In *a* the pelves are overlapped (matched) one on the other. The clips indicate the descent of the uterus in the pelvis during contraction. Dotted line *a* with its ascent during relaxation. *b* *B* the clips are overlapped (matched) one on the other. The relation of the heads of the two rays indicates the motion of the presenting part within the uterus. Dotted line *a* is the level attained during contraction while the



blocked figure *b* indicates the ascent within the uterus during relaxation

head was compelled with the chin under the pubis. The size of the dolichocephalus forced the passage of the occiput with the superior fetal thorax. A dead baby boy was delivered. Skin clips were removed from the cervix. The placenta was expelled complete with a loss of 500 cubic centimeters of blood. The episiotomy was carefully repaired with chromic No. 2 catgut. The patient subsequently developed pyelitis with slight infection of the perineal region. Autopsy of the child showed intracranial hemorrhage and pulmonary atelectasis.

X-ray negatives show occiput posterior, chin anterior with marked dolichocephalus, clip attached to anterior cervical lip.

First comparative tracing shows slight descent of uterus into pelvis during contraction with ascent during relaxation.

Second comparative tracing shows expulsion of the head out of the cervix approximately  $\frac{1}{4}$  inch with its ascent during relaxation and excursion of  $\frac{3}{4}$  inch of fetus within uterus.

CASE 3 Mrs. J. L. M. aged 23 years, primipara, housewife, enjoys life, no worries. Father, mother, and one brother were living and well. Menstruation commenced at 14, recurred regularly every 28 days and lasted 4 to 5 days with no pain or leucorrhoea. The last period had occurred March 8, 1928. Patient had been fairly well all her life. She had had menses, mumps, and sore throats prior to tonsillectomy 2 years previously.

Patient had had no nausea or vomiting during the first trimester; there had been slight filling of the breasts, but no frequency. She felt life at 4½ months. Physical examination disclosed a well-developed, well-nourished woman of staid age with no enlargements of the lymphatics. The eyes, ears, nose, and mouth were normal. The neck presented no masses or enlargement of the thyroid. The apex beat of the heart was in the fifth interspace in the midclavicular line. The pulse was regular, the heart beats 78 p. minute. Blood pressure was 118-80. The abdomen presented no masses or tenderness. The uterus was enlarged with child. Rectal and vaginal examinations disclosed a birth passage free from obstruction and a soft cervix. Pelvic measurements were as follows: interspinous 24, intercrural 27, intertrochanteric 33, bituberous 8, external conjugate 20, internal conjugate 13, allowing for body thickness 9.

Labor started at 3:00 a. m. December 23, 1928. Mercurochrome preparation with introduction of skin clip was done at 6:10 p. m. At 7:20 p. m. 1/100 grain of scopolamine with 1/8 grain of morphine sulphate was given. Dilatation measured 3½ centimeters at this time. At 9:15 p. m. 1/100 grain of scopolamine was given; dilatation was complete. One two-hundredth grain of scopolamine was given at 1:30 a. m. December 24, 1928. At 1:45 a. m. ray pictures were taken. Ether anaesthesia was administered at 2:30 a. m. At 3:30 a. m. forceps were applied with rotation (DeLee's maneuver) and a fairly deep episiotomy was performed in left posterior oblique. A female child which cried spontaneously was delivered at 3:17 a. m. The placenta was delivered complete with single Cordé pressure at 3:20 a. m. At 3:30 a. m. the clip was removed and the perineum repaired.

X-ray negatives show occiput posterior position, complete dilatation, clip attached to anterior lip of cervix.

First comparative tracing shows slight descent of uterus into pelvis during contraction with ascent during relaxation.

Second comparative tracing shows expulsion of the head from the cervix approximating ½ inch with its ascent into the uterus during the immediately following period of relaxation.

CASE 4 Mrs. K. I. M. aged 21 years, typist and homemaker with domestic worries. Father, mother, 4 brothers, and 4 sisters were living and well. Patient had been married 6 months. Her husband was well. Menstruation commenced at 13, then 15; it was regular from then on every 28 to 30 days, lasting 8 days with terrible pain for 1 or 2 days. Patient had had some leucorrhoea since the first period. The last flow had started March 23, 1928. Patient had had measles, mumps, scarlatina, pertussis, diphtheria, pneumonia, influenza, and sore throats up to 5 years previous. Patient had had appendectomy and treatment for varicose veins.

The patient flowed for one day on June 5, 1928, and had slight bleeding for a few minutes on June 21, 1928. She had some vomiting and frequency but very few breast changes. Bleeding occurred again according to the patient in the eighth month, but this hemorrhage was not observed by the attendant or consultant. Physical examination disclosed a well-developed, well-nourished young woman. Her skin and mucosa were of normal turgor, moisture, and texture. No lymphatic enlargements were present. No tenderness was elicited on palpation over the sinuses. The eyes, ears, nose, and mouth were normal. The neck presented no enlargements. The apex beat of the heart was in the fifth interspace, midclavicular line. The lungs were clear on percussion, palpation, percussion, and auscultation. No masses or tenderness were present in the abdomen. The uterus was enlarged with child and was slightly larger than the corresponding period of gestation. Rectal and vaginal examinations showed no obstruction to the birth passages. The cervix was normally soft but firm. Pelvic measurements were as follows: interspinous 21, intercrural 21, intertrochanteric 30, bituberous 8, external conjugate 18, internal conjugate allowing for body thickness 9. This patient gave a history of bleeding several times during gestation. Careful examination offered no evidence of placenta previa or other pathology. The fetal heart rate remained constant throughout the periods of inspection. The urine remained free from sugar and albumin and the blood pressure below 120-80.

Labor started at midnight, December 30, 1928. At 10:00 a. m. intravaginal mercurochrome preparation was done and a skin clip was introduced in the cervix and another one in the anterior vaginal wall. Scopolamine in the amount of 1/100 grain and morphine sulphate in the amount of 1/8 grain was administered at 10:20 a. m. At 12:00 noon 1/100 grain of scopolamine was given. At 1:00 p. m. the head was above the spines and there was 1½ centimeters of dilatation. One two-hundredth grain of scopolamine was given at 5:00 p. m. At 6:20 p. m. the head was above the spines and there was 3 centimeters of dilatation. Scopolamine in the amount of 1/200 grain was given at 8:20 p. m. At 9:10 p. m. the membranes ruptured and dilatation was complete. At 9:40 p. m. an X-ray study was made while the vulva bulged and separated so that the head was just visible. A baby girl was delivered spontaneously without laceration at 9:59 p. m. and the clip removed. The placenta was delivered complete at 10:05 p. m. with single Cordé pressure. The loss of blood amounted to 150 cubic centimeters.

X-ray negatives show occiput anterior—rotated from occiput left anterior with clip attached to anterior vaginal wall at the approximate level of the cervix at start of labor, while lower lip is in the anterior lip of the cervix.

First comparative tracing shows descent of uterus into pelvis of 1 inch during contraction with its return into the pelvis during relaxation.

Second comparative tracing shows expulsion of the presenting part from the cervix a distance of 1½ inches during contraction with its ascent into the uterus during the

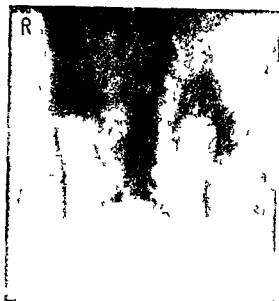


Fig. 10 Case 4 First X-ray film taken during contraction. Dilatation complete. Position left occiput anterior rotated into occiput anterior. Clip in anterior lip of cervix and also one in anterior wall of vagina.



Fig. 11 Second picture taken during the immediately following period of relaxation.

apex beat of the heart was in the fifth interspace in the midclavicular line. Blood pressure was 82/54. The lungs presented no variance from normal on percussion or auscultation. There was some tenderness over the appendiceal region. The uterus was large with child in the occiput posterior position. Rectal and vaginal examinations showed no obstruction to the passage of the birth product. The cervix was soft. Pelvic measurements were as follows: interspinous 23, intercrural 26, intertrochanteric 32, bituberous 7.5, external conjugate

18, internal conjugate 10.5, with allowance for body thickness 8.5. This patient appeared only twice during her pregnancy and was extremely difficult to manage because of ignorance.

Labor started June 19, 1928 at 5:00 a.m. Intravaginal mercurochrome preparation with introduction of clip was done at this time. At 10:25 p.m. rupture of the membranes occurred at the approximate time of complete dilatation. X-ray study was made at this time. The patient was placed under ether and version was attempted first, then forceps rotation with deep episiotomy. The fetal heart beat fell to 40 per minute and the delivery of the

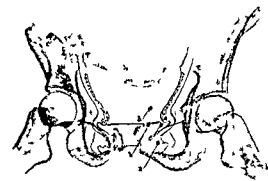


Fig. 12 Comparative drawing. In 1 the pelvis are overlapped (matched) one on the other. The clips indicate the descent of the uterus in the pelvis during contraction. Dotted line *a* with its ascent during relaxation. In 2 the clips are overlapped (matched) one on the other. The

relation of the head indicates the motion of the presenting part within the uterus. The dotted line *a* is the level attained during contraction while the blocked figure *b* indicates the ascent which is made within the uterus during relaxation.

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See second paragraph of article



period of relaxation immediately following—an excursion of the birth product within the uterus of  $1\frac{1}{2}$  inches

The mechanism of labor, then as shown by these X ray studies, presents two relations—one between the uterus and the pelvis, the other between the birth product and the uterine interior

From the start of labor, there is a descent of the uterus within the pelvis during contraction and an ascent during relaxation. This process continues throughout labor and the excursion of the uterus within the soft parts of the pelvis constitutes from  $\frac{1}{2}$  to 1 inch except where fixation of the head occurs, when it is less, or where there is stretching of the ligaments when it might be more

In addition to this action of the uterus, there is an excursion of the fetal presenting part within the uterus. This starts as a very minute departure of the presenting part from the uterus (or retraction of the lower uterine segment) at the start of labor, and as dilatation becomes more marked the excursion of the fetus within the uterus is increased. Thus at 3 centimeters' dilatation it might be  $\frac{1}{8}$  of an inch, increasing gradually to an excursion of  $\frac{3}{8}$  of an inch at complete dilatation, head at the spines, finally attaining a maximum of  $1\frac{1}{2}$  inches' excursion when the force of the perineum adds its back pressure to the motion of the relaxing lower uterine segment. At this stage, the combination of the movement of the uterus within the pelvis and the movement of the fetal parts within the uterus allows for a descent of the fetal presenting part of  $2\frac{1}{2}$  inches within the pelvis during contraction followed by its ascent during relaxation

Thus, the presenting part acts as a swab, smearing bacteria from the vagina onto the interior of the uterus. The studies on cesarean section (mentioned above) give some conception of the time required to produce this action which increases as labor progresses

To this method of spread of infection must be added any manipulation or operative delivery undertaken at the time of parturition. But in an uncomplicated case, that is a case in which vaginal examinations have not been made, in which forceps have not been applied, in which version has not been done, in which a bag has not been inserted, in which the placenta has not been removed manually, in which episiotomy has not been done, in which no tear has been produced, in which hemorrhage has not occurred, in which the membranes have not ruptured, and which is not complicated by placenta prævia, in a case delivered without attendants and without acci-

dents, there may still be a fatal infection which will develop from the action of the labor itself as herein described and shown by the X ray examination. To all other factors of infection, which have been demonstrated as responsible for puerperal sepsis must be added that of the mechanism of labor itself

In order to counteract this method of contamination, every case of labor must be approached as a surgical operation. These cases should all receive some antiseptic preparation intravaginally early in labor prior to the delivery of the baby, and this intravaginal antiseptic should be non toxic and non irritant and applied sufficiently often to be effective in destroying the vaginal flora. The results of Mayes De Lee and Hirst show that the morbidity has been reduced one half by means of these methods

#### SUMMARY

The mechanism of labor has been suggested as an etiological factor in puerperal infection, and to confirm this opinion a study has been made of the relation of the uterus to the pelvis and of the presenting part to the cervix, by the introduction of a clip into the anterior lip of the cervix and the exposure of X ray films during the period of contraction, and again during the relaxation immediately following. These films show descent of the uterus within the pelvis and of the fetal presenting parts within the uterus during contraction—with ascent of the uterus within the pelvis and ascent of the fetus within the uterus during the period of relaxation immediately following

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in the upper ureter were primary features of the obstruction. Therefore one should be very careful in the selection of cases for renal fixation for the correction of such kinks, unless there be a definite kink which cannot be explained by lower obstruction and one in which there is proved to be renal pain by its reproduction through filling of the pelvis, or in which there is true evidence of beginning hydronephrosis. Otherwise renal fixation should be shunned. Aberrant vessel must always be borne in mind.

Shortening of the ureter is observed chiefly in three conditions: in tuberculosis, and in two congenital lesions, the horse shoe and the ectopic kidney.

In the presence of indefinite masses in the abdomen, a study of the ureteral and pelvic topography will frequently establish a diagnosis. I observed an example of this not long ago in a girl who presented a tender lower abdominal mass which was believed to be an abscess of the appendix. As there was pus in the urine she was referred to our department. A ureteral catheter was passed up the right ureter a much shorter distance than usual and recovered purulent urine under tension. The case proved to be an acutely infected hydronephrosis in an ectopic kidney.

Supernumerary ureters occur in about 1 per cent of cases. Double reduplication is present in about 18 per cent of these. Felix, Braasch, Harpster, Brown, Delcher, Mertz, Wedensky and Lewis have written extensively on this subject. Kidneys having such ureters seem susceptible to disease. It is estimated by these authorities that 27 to 40 per cent of double ureters are associated with renal disease, particularly hydronephrosis, infection, and stone. It has been my experience that the upper pelvis, the smaller one, is more susceptible to disease. The double ureter is particularly apt to be productive of renal pain in which no definite clinical cause can be determined. I have seen several patients with colic without stone, stricture, movability, or pyelographic evidences of obstructions, who have had recurrent intermittent colics and the pain was typically renal and could be reproduced. In the light of the recent knowledge on peristalsis, it is possible that the crossing of the ureters interferes with normal peristaltic progression and possibly a reversal of the current with temporary blockage is the result. Surgically the problem is oftentimes the same as that for a single ureter but frequently has the advantage of lending it self to heminephrectomy.

Whether the cause of the obstruction be congenital or acquired, the one characteristic accom-

paniment is stasis. Ureteral stasis is the most important cause of renal infection. Of the 2,100 cases of kidney infections which I analyzed 2 years ago, 80 per cent were associated with stasis from ureteral insufficiency. Hence the significance of thorough drainage.

One type of ureteral obstruction which has received but little recognition is the self engendered obstruction occurring at the ureteropelvic juncture. As a result of primary renal infection, with consequent swelling of the outlet, a vicious circle is created and is responsible for the so called acute pyelitis in many instances. It is in this type that prompt evacuation through the ureteral catheter insures restoration of renal function and protects the kidney against scars and inflammatory invasions which may later lead to untoward developments.

Acquired pathological obstructions of the ureter are legion and enumeration is unnecessary. Your familiarity with this subject makes me almost hesitate to mention briefly a few of the important ones.

The surgical significance of stone was shown by the fact that 7 per cent required ureterotomy. About 93 per cent can be removed by endovesical, endo ureteral technique. Patience, careful vigilant observation, and asepsis are necessary. Frequent radiological study and repeated functional tests must be employed. If a stone shows a tendency to descend and the urinary function remains normal, if infection is absent or slight and renal drainage is efficient, one is usually safe in continuing manipulative measures.

The insidiousness of ureteral calculus can best be illustrated by a patient whom I saw 2 years ago with a stone the size of a large almond in the renal pelvis. A ureterogram showed a normal ureter below the stone. Renal function was undisturbed. The patient disappeared for 6 months and returned having had no symptoms suggestive of disturbance in the kidney or ureter. The stone was at the vesical end of the ureter, the kidney completely destroyed and the other kidney doubly compensated. Ureterotomy would have saved the kidney. The silent travel of this large stone along a previously determined normal ureter is a warning against waiting for symptoms and signifies the necessity of repeated observation.

The technical problems of stone removal are familiar. In the upper ureter they are simple, in the lower either simple or extremely difficult. In the midureter the Gibson incision is all that one can desire, in the lower end of the ureter the Judd technique has simplified the removal of stones considerably. In the female, the vaginal

## THE SIGNIFICANCE OF THE URETER IN SURGERY

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THE importance of the ureter in the architecture of the human machine and the part it plays in the natural behavior of this machine were little understood and less appreciated until recent years. We now find that through the medium of minds devoted to the solution of its many important problems the intricate physiological and pathological characteristics of this organ are well known and today the discussion of it occupies one of the great chapters in urology.

The ureter not only has to contend with its own diseases and disturbances in function, but it may be the cause of many of the lesions in the kidney requiring surgery. Lesions in the ureter, because of its reflections and radiations, may produce symptoms characteristic of other intra-abdominal lesions, notably appendicitis, the ureter, because of its location, may be injured during a pelvic operation, lesions of the ureter because of its reflections and invasions may produce symptoms similar to those associated with lesions of the bladder and urethra, finally, developmental anomalies of the ureter may offer an explanation for certain malformations in the bladder which have heretofore been considered of truly vesical origin.

The essential function of this highly specialized tube is to transport without impediment urine from the kidney to the bladder. Unfortunately, embryological defects and pathological conditions frequently interfere with perfect function. Embryological defects occur most often at the site of the normal physiological narrowings as valvular remnants or sclerotic processes or they are the result of faulty development of the wall itself. Thus we may expect the dilated, tortuous thin-walled ureter, usually producing pronounced renal disturbance, or the massive rather straight, thick-walled duct producing little or no effect upon the renal substance, the latter being the megalo-ureter. Unless the obstructive lesions be cared for early, disastrous consequences may result to the kidneys necessitating either their removal or palliative drainage operations. Fortunately, these obstructions occur most frequently at the vesical end of the duct and often may be corrected by simple cystoscopic surgical intervention with slitting of the orifice, in other cases open plastic surgery is necessary.

In cases in which it is doubtful that, after careful ureteral catheter drainage, renal function will be restored and infection overcome it is unwise to incise the orifice because of the danger of producing urinary fistula through regurgitation in case nephrectomy is necessary later.

The pronounced obstructions at the vesical end of the ureter I have corrected satisfactorily by the transposition operation which I described in 1918. This consists in the excision of the intramural ureter as far as its entrance to the bladder wall and the moving of the orifice back to this location. This usually permits the surgeon to remove the sclerosis. In the several cases in which I have used this technique the results have been extremely satisfactory. Frequently this condition is bilateral. The chance of recontraction after the operation described as compared to that after ureterovesical anastomosis is minimized. The operation is much simpler and is accompanied by fewer complications. The normal attachment of the ureter is retained and in my opinion this is to be desired.

The changes in caliber are productive of the most important chapter on ureteral diseases. Other developmental defects which occasionally confront us are anomalies in number, variations in length and faulty insertion.

A present day delusion in urology concerns ureteral redundancy in the shape of kinks and twists. Pages have been written about their responsibility for kidney disease, a manifold symptomatology such as pains, general nervous manifestations and the like being ascribed to them and numerous operations upon the kidney being suggested for their correction. As an individual may have a long nose so he may have a long ureter. Many redundant ureters are physiological and co-incidental in the field of symptoms. Some occur as the result of excessive renal mobility and necessitate surgery for their correction. Some result from aberrant vessels. The majority result from obstruction at the lower end of the duct. One of the first variations from the normal that a ureter undergoes following ligation at its lower end is an elongation and tortuosity in the region of the renal pelvis.

In the work on experimental ligation which Dr. Fisher and I did a number of years ago we invariably found that the kinks and tortuosities

proposed by Engelman in 1869 that these waves are of myogenic origin. Since they occur more frequently in the part of the ureter in which ganglion cells have been found by some, it has been suggested that the ganglia may possibly be responsible—a fact not sanctioned by most observers. Some believe that the contractions are initiated by stimulation of the ureter by chemical substances in the urine, particularly urea, others that the mechanical pressure of the urine is responsible.

The preponderance of contractions in the upper and lower segments of the ureter bears a definite significance to clinical medicine. It is in these locations that strictures have been reported so frequently. It is here also that pathological changes are more frequent, that is stones in the renal pelvis, inflammatory conditions in the true pelvis and lower abdomen such as the seminal vesicle, pelvic inflammatory diseases and appendiceal conditions. Hence the proximity of such irritating lesions to such receptive muscle fibers as the ureter possesses may in many instances explain the pronounced contractions which are seen in these vicinities. Thus our surgical therapy might well be directed to the correction of these pathological changes rather than to manipulative technique upon the ureter itself.

The recent work of Gruber in the Pharmacological Department of Washington University on peristalsis and antiperistalsis is extremely illuminating. By a special apparatus he has been able to show peristalsis present in the excised whole pig ureter. He has demonstrated that the wave propels fluid ahead of it within the lumen of the ureter and is, therefore, a true peristaltic contraction independent of the central nervous system. He has produced spontaneous peristalsis and antiperistalsis in excised pig ureters 108 hours after excision which length of time would seem long for nerve cells to survive. He has furthermore proved conclusively that a definite reversed peristalsis occurs spontaneously and may be created by means of thermal, electrical, chemical and pharmacological influences. Such an observation lends itself admirably to the explanation of the rapid back fire of stones from the ureter to the kidney pelvis, as has been observed by so many surgeons. This type of ureteral contraction furthermore could aid in the transportation of infection from the lower ureter to the kidney.

Peristalsis and antiperistalsis may occur simultaneously in the same ureter. It is, therefore, not unreasonable to assume that some of the pe-

culiar filling defects and spindle dilatations may be the result of this antagonism.

The exact mechanics of the protective device at the ureterovesical orifice has been shrouded with confusion until recently. Our conception has been that the obliquity of the ureter through the bladder wall served to protect the vesical contents against regurgitation up the ureter.

In 1903 Sampson was the first to describe a valve mechanism. Other observers have spoken of sphincter in one sentence and valve in the next, but no definite information has been available until recently when Gruber beautifully demonstrated the presence of a definite ureterovesical valve in humans, dogs, rabbits, monkeys, baboons, cats, and pigs. The valve is a single flap affair, composed chiefly of connective and elastic tissues, a few smooth muscle fibers, and mucous membrane from the ureteral and vesical side. It varies in length in different animals. Gruber and other observers have shown that there is no definite sphincter in this region. The valve is the potent factor in the security of the orifice. Incision of this valve without disturbance of the intramural ureter is sufficient to allow prompt regurgitation of contents of the bladder into the ureter, and the pressure within the ureter immediately assumes intravesical pressure, where as the normal ureter remains uninfluenced. The experiments of Gruber coincide with clinical observation and are at variance with the results of Graves and Davidoff. This may be explained by the fact that in their experiments the animals were either anesthetized or narcotized and the bladders were filled beyond normal distention. Hence the valves were rendered incompetent through narcosis and overstretching.

The importance of this valve cannot be overestimated and its protective influence is remarkable, yet its delicacy explains the frequent occurrence of its incompetency in the face of invasion with inflammation, neoplasm, or pronounced protracted distention. This explains the occurrence of the chill and fever accompanying the closure of a suprapubic wound. It would seem to be the result of regurgitation of the infectious material into the renal pelvis from increased vesical pressure.

Incompetency of the valve offers a very fitting explanation for ascending renal infection and offers us recompense as surgeons for bladder drainage to correct renal infections resulting from vesical neck obstruction. It explains the mortality in many cases of carcinoma of the bladder from pyelonephritis and the infection of one kidney from a tuberculous lesion of the

approach proposed by Lower has many recommendations. Whether one should close the ureter after ureterotomy is a debatable question. As far as gross leakage is concerned, it matters but little. It appears to me, however, that definite approximation of the ureter to prevent a peri-ureteritis in the neighborhood of the incision is advisable.

In the removal of stones from the ureter it is very important to lavage the site of implantation thoroughly in an effort to remove all sandy deposits and to give a follow up dilatation and lavage during convalescence at least by the tenth day. With this I feel positive that recurrence of stone in the ureter should be very slight, not more than 2 per cent.

Stricture of the ureter occurs as a definite cause of obstruction and at times leads to great mutilation of the kidney. A great deal has been written on the subject of stricture and I shall not relate the story of its many phases. Hunner, in his repeated discussions on this subject, has emphasized the frequency and importance of stricture, and to him belongs great credit for directing attention to ureteral investigation. One should be rather guarded in designating constrictions of the ureter seen in ureterographic study as stricture, and certainly equally guarded in the interpretation of impressions from large bulbs because after all the ureter is a highly specialized involuntary muscular organ the chief mechanism of which is dependent upon muscular activity susceptible to influences from within and without and physiological contractions are frequently confusing in this picture. There seems to be a decided tendency to magnify the importance of these slight constrictions and dilatations and to ascribe to them a pathological significance when they merely represent true physiological conditions. Unless there be a persistent finding in the same location associated with definite evidences of pathological change above such as early or late dilatations of the renal pelvis, the diagnosis of stricture cannot be accurately made.

Spasms of the ureter which appear on first examination to be typical strictures may disappear, either spontaneously or under the influence of smooth muscle relaxants, particularly atropin and papaverine. Morphine of course while it has been currently given to relax ureteral spasm, has been proved to have the contrary effect; it is a smooth muscle stimulant and has its effect in relieving the patient only by numbing the general sensibilities. Its association with atropine makes it effective in ureteral colic.

Neighborhood inflammatory lesions or the presence of calculus will very frequently cause constrictions and contractions of the ureter in the vicinity. I have on several occasions removed calculi from the pelvis of the kidney expecting to find stricture at the upper ureter as evidenced by ureterographic study and have found the ureter perfectly normal anatomically.

This brings up the important question of ureteral study, namely, the consideration of its muscular movements or its propelling force. In conveying the urine from the kidney to the bladder, the ureter is not only a passive conductor but an active organ. The propulsion of urine is created by means of peristaltic contractions of the ureter, but additional factors such as intra-ureteral pressure due to urinary secretion from the kidney, gravity in the erect posture contractions of the diaphragm, peristalsis of the intestine, pulsations of the arteries crossing the ureter and in the vicinity of the ureter and active contractions of the abdominal muscles assist in its function.

In comparison to the peristaltic contractions this latter group of contributory factors possess but little influence. The ureter, like the intestine, possesses three distinct types of movement: pendular, peristaltic, and antiperistaltic.

The function of the pendular movements is unknown. That they do not propel fluids in a given direction for any distance is the only fact which is known.

The peristaltic and antiperistaltic contractions are the most important and are the ones which chiefly concern us. The existence of peristaltic contractions in the ureter have never been disproved since they were described 60 years ago. An extensive literature has accumulated concerning their origin and their mode of propagation. In summarizing the various ideas on this subject it may be definitely stated that the impulses start at the tips of the calyces, and pass downward toward the bladder. They are most active in the upper ureter, least in the middle ureter and again quite active in the lower ureter. In other words there is not a definite metabolic gradient.

Early investigators, Budge and Valentin believed them to have their origin from impulses sent from the central nervous system but since innumerable observers have demonstrated beyond question that the isolated and denervated ureter possesses these contractions as well as the normal, it is obvious that the central nervous system can play no rôle in their production. Their exact nature is still not definitely understood. The theory usually accepted is the one

Uretero intestinal anastomosis and uretero cutaneous implantation offer no novel features and limited space prevents further comment.

The importance of defective development of the ureter in the production of congenital lesions frequently seen in the bladder is the feature of this discussion which I wish particularly to present. It has been my impression for many years that the true diverticulum of the bladder is congenital. Its opening seems to present a definite, well defined, sphincter like margin, its walls are usually thick, and the location is usually in the neighborhood of either ureteral orifice or in the region of the urachus. Furthermore, I have never been able to reconcile myself to the belief that a small blister of mucous membrane of the bladder could dissect its way through its walls and develop into a sac of any considerable size. Also if the diverticulum were caused by dissection it would seem that the orifice should assume various shapes and most likely present an angular or slit like arrangement rather than a circular one.

My impression has been that maldevelopment of the ureter might explain this condition. A recent observation in an infant girl seems to offer proof to this credence. In catheterizing the right ureter for a very acute resistant pyelonephritis complicating empyema I casually observed a double orifice on the left side. Her illness prevented investigation at this time but the ureteral catheter drainage produced a prompt recovery from symptoms and in a short time another cystoscopy gave the following information: the double orifice on the left at first revealed nothing unusual then suddenly the outer, somewhat crescentic orifice opened and assumed the typical appearance of a diverticulum. Shortly afterward the inner orifice was seen to enter this opening through a process of contraction. A little later the two retracted and the orifices assumed their original positions. This was observed repeatedly. A catheter could pass in the outer orifice for 2 centimeters. This performance was spontaneous and not dependent upon different degrees of vesical filling.

A misdirected ureteral bud which was designed for a double ureter was responsible for this condition and in all probability such an affair is the source of many diverticula of the bladder. The longer the ureteral stump the larger the diverticulum. With respect to the formation of the sac it has been shown that if the valve is defective the normal contractions of the bladder during the acts of urination over a period of time are suf-

ficient to dilate the ureter and in such an instance to produce the sac. Obstruction is not essential. If nature has been so inefficient as to produce a defective ureter, we may expect it to be equally so in perfecting its valvular mechanism.

The tuberculous ureter is replete with surgical problems, different surgeons employing different methods—complete or partial ureterectomy, drainage and closure without drainage, medication and non medication. Some apply different techniques to different types of ureteral involvement all with about the same end result. My personal experience in more than 100 cases of nephrectomy for renal tuberculosis has convinced me that the ureter needs no extravagant surgery but should, in the majority of instances, be ligated at a suitable distance from the kidney, preferably with cautery, and allowed to drop back into its position without drainage. I have never had a persistent fistula from a diseased ureteral stump. The majority of such fistulae are kept open by the tuberculous process in the region of the renal pedicle from the perirenal fat involvement. I have observed but one instance of late trouble from a tuberculous ureter, this occurred 2 years after nephrectomy for an early tuberculosis in which there was little involvement of the ureter. The patient presented pain in the lower right quadrant and slight fever. The pin point ureteral orifice was dilated and inspissated pus was evacuated. Prompt relief resulted with no recurrence for 6 years.

The ureter occupies a most prominent place in surgery of the kidney. It is the means of simplifying proper exposure of the pedicle in nephrectomy—if the ureter is freed and used as a tractor that is, lifted up while it carries the kidney with it, easy access to the pedicle of the kidney is insured and the danger of hemorrhage and injury to surrounding structures is minimized.

In fixation of the kidney it is extremely important that the ureter be freed and the kidney placed in a position in which the ureter presents an accurate alignment. In all stone operations, whether pyelotomy or nephrotomy, the patency of the ureter is of paramount importance.

The shunning of the ureteropelvic juncture in pyelotomy needs no comment and the protection of the posterior pelvic vessels is thoroughly appreciated.

But a few of the problems of ureteral surgery are presented. As time goes on, the innumerable investigators stimulated by important recent discoveries will solve many of the unexplained phenomena still existing.

bladder is a result of infection in its mate. Indeed, regurgitation of the contents of the bladder into the ureter is far more common in such lesions than it is in pure simple obstructions.

In 8 per cent of 1036 cystograms examined by Bumpus there was regurgitation. In 300 cases which I observed it was present in 6 per cent.

The importance of this valve should make us extremely cautious in making free incision to remove calculi and to correct slight contractions at the orifice.

The fact that the characteristics of ureteral disease are similar to those of abdominal disease is thoroughly appreciated by surgeons. This similarity is the result of the reflections of the ureter in the regions of the appendix, in the pelvis and even in the upper abdomen.

Before the days of real scientific accuracy in differential diagnosis the hidden unsuspected ureter caused at least 27 per cent of the pains which were ascribed to the appendix and for which appendectomy was performed. The gall bladder was the recipient of a few such insults as were also the stomach, intestines and pelvic organs. Today investigation has helped to relieve this situation and in the presence of any vague abdominal pain the ureter should not be overlooked as a possible causative factor.

As I once remarked, the surgeon should step less lightly on the smooth pavement lining of the peritoneal highway and confine many of his meanderings to the stony gutters in the rear.

The implication in pelvic surgery is an embarrassing but not an uncommon occurrence. The most frequent causes of injury are ligation in cision, and circulatory interference with pressure necrosis from clamps. Ureteral ligation predominates. It has been estimated by various observers that from 1 to 3 per cent of operations on the female pelvic organs are complicated by this unpleasant feature. This applies particularly to vaginal hysterectomy.

Fortunately, for the surgeon the condition is unilateral in the majority of instances. It is equally unfortunate for the individual since renal sacrifice is the rule whereas in bilateral ligations, which occur in about one third of the instances, corrective measures must be instituted to save life and renal substance.

In the experimental work which Dr Fisher and I did in 1915 it was shown definitely that immediate nephrostomy would preserve kidney integrity and insure the thorough restoration of the lumen of the ureter. In my clinical experience and in this experimental study it was found that the ligature never absorbed before 3

weeks and that the lumen of the ureter opened in from 6 to 8 weeks and the fistula closed usually within 10 weeks. In other words, one can never hope for the absorption of catgut before the death of the kidney. The relief of back pressure upon the kidney preserves the organ until the ureter eventually assumes its patency. Our experience is that this procedure is far better than deligation, which entails an extensive open ration through a raw surface on a sick patient and subjects the ureter because of its tension and the imbedding of the ligature to the further possibility of fistula. Time will not permit a discussion of the other ureteral injuries except to mention that certain ureteral fistulae may heal with distention from below, others may require uretero-ureteral or ureterovesical anastomosis while in many nephrectomy is necessary. Uretero-ureteral anastomosis, while effective in the freshly injured ureter where shortening and fibrosis has not implicated it, is far from successful in many of these lower pelvic injuries. The plastic anastomoses of the ureter by the accepted methods will give excellent results particularly in the upper accessible ureter. Some surgeons, notably Quincey in case of aberrant vessel cut the ureter and anastomose it rather than ligate the vessel which is obstructing it.

In discussing ureteral plastics I should cite one instance which speaks for the remarkable reconstructive, regenerative power of the ureter. In a resection of a very large, densely adherent diverticulum of the bladder, the lower end of the ureter surmounting the sac which was considerably thinned and invaded was torn during the process of resection. An attempt to anastomose it to the bladder at the end of the operation was made and the ureter was found to be so shortened as to make such a procedure impossible. I inserted a large, soft rubber catheter in the somewhat dilated ureter, placed it into a rent in the bladder, secured the catheter within the ureter by catgut ligature and then by traction sutures between the lower end of the ureter and the bladder fixed the catheter and ureter in position. The ureter was at least  $1\frac{1}{2}$  inches from the bladder which I had mobilized in an attempt to do the transplantation. The wound was closed with drainage. Within 3 weeks the catheter was removed from the bladder and the urine passed normally from the kidney into the bladder. Later the ureter was catheterized and cystogram showed normal connections. Thus the ureter like the urethra possesses an uncanny regenerative ability if properly bolstered. The rubber in all probability stimulated cellular activity.

The stroma of the cancer cell is the measure of nature's resistance. The greater the amount of stroma and the less the proportion of cells, the slower the growth. On the contrary, the greater the proportion of cells and the less their resemblance to the normal tissue involved, the more rapid the growth. All there is to cancer is contained within the malignant cell which has a remarkable resemblance to the rapidly growing embryonic cells of the chorionic villi (Langhans' cells). Langhans' cells have extremely large nuclei and undergo the most rapid division of any normal cells in the body, but the nucleolus and the cytoplasm of the cell have no peculiarity of structure.

Wilson, MacCarty, and Broders have enlightened us greatly with regard to the histological character of the cell in relation to malignancy, upon which Broders' classification of the malignancy of tumors has been based. In brief, it has been found that when malignant cells are compared with the rapidly growing normal cells, the nucleolus as well as the nucleus is found to be greatly enlarged. It would appear that the size of the nucleus controls oxidation in the cell in relation to its increased blood supply whereas the nucleolus controls the function. The increase in the size of the nucleolus as well as the nucleus means rapid and uncontrolled production of cells without function which is characteristic of cancer. In other words the greater the variation of the malignant cell over the normal, the more malignant the growth.

The studies of Murray on tar painting those of Gye and Barnard on the transplantation of the Rous fowl tumor, the work of Shye on cancer in mice, and of Bowing and Desjardins on the effect of radium and X ray in lessening the malignant character of the growth, all point to local and general susceptibility as being perhaps the controlling factor

in the genesis of malignancy, and indicate that the possibilities of increasing resistance to cancer in the more susceptible individuals is not only a possibility but a goal which every effort must be made to reach.

W J MAYO

## THE ACUTE CRISES OF HYPERTHYROIDISM

THE acute crisis which occasionally appears in a patient with hyperthyroidism is at least in large measure controllable if proper measures to combat the condition are undertaken early enough. Even if the condition has progressed to the later stages of the state, when the patient is vomiting, delirious, and uncontrollably agitated, proper measures will, in a considerable number of cases, overcome the acute crisis and permit the patient to be gotten into such a state of improvement that subtotal thyroidectomy can be done.

On the other hand, it is true that a very definite number of patients, who have been permitted to progress into the later stages of thyroid crises will go progressively on into deeper stages of the state, with uncontrollable vomiting, diarrhoea, delirium, and restlessness and die in spite of all measures which we now have at our command, including iodine.

Since we know from our practical experience that this is so, it is urged that any indication of an approach to the condition of a thyroid crisis, such as marked increase in activation, sudden intensification of the signs of thyroidism diarrhoea, and particularly vomiting, with changes in the mental state, be considered an emergency, just as an impending diabetic coma is, and urgent measures to combat it be immediately instituted.

The salvation of patients with an impending thyroid crisis are glucose, iodine, fluids, and morphine fifty grains of glucose in five hun



# EDITORIALS

## SURGERY, GYNECOLOGY AND OBSTETRICS

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AUGUST, 1929

### SUSCEPTIBILITY TO CANCER

THE incidence of cancer in various countries which compile reliable statistics is about the same not only as to population ratio, but also as to sex, although the organs or tissues which are most susceptible to the disease vary considerably. Whereas 30 per cent of cancers in the female involve the breast and the uterus in the male about 30 per cent involve the stomach and the organs of the urinary system.

The testis is the primitive reproductive organ, and the ovary is descended from the testis. It is possible that the longer heredity of the testis has given it great resistance to various forms of insult to which the ovary has relatively less resistance.

Cancer never develops in sound tissues. Chronic irritation, by opening up an atrium for possible entrance of micro-organisms to the body from the outside, seems to suggest an external agent. This does not explain why in certain cases in which the sources of chronic irritation are very slight, cancer develops, while in others in which the sources of chronic

irritation are very extensive for great lengths of time, cancer does not develop. It is difficult to surmount the fact that when cancer has extended by metastasis to a new situation, it produces the histopathological picture of the tissues in which it originated rather than that of the organ which became affected secondarily. If the disease were due to a foreign invader, it presumably would reproduce the type of cells of the newly invaded tissue rather than that of the primary seat of the tumor.

In any event, the agents which act on the cell to produce malignancy become an integral part of the cell itself, as metastasis in the human species takes place only by transplantation of the cell.

One factor of supreme importance which has not been sufficiently stressed is that individuals vary in their susceptibility to the cause or causes of cancer, whatever they may be. In no other way can we explain why 90 per cent of persons do not have cancer and 10 per cent die from it. It is as logical to accept the hypothesis that 90 per cent of persons have greater resistance to cancer than the 10 per cent, as to attempt to force an explanation that only 10 per cent come in contact with hypothetical causative agents which produce cancer.

If the patient's susceptibility to the disease is the important factor in the development of cancer, the situation of the growth must be determined by the organ or tissue subjected to the insult of the precancerous lesion, and the grade of malignancy and the metastatic possibilities by the susceptibility of the body as a whole.



dred cubic centimeters of saline twice in twenty four hours Lugol's solution by mouth, by rectum, by stomach tube, or in the salt solution, and morphia up to the point at which restlessness is controlled or the therapeutic danger point is indicated by the respirations

It is urged that these measures be not reserved as a treatment of thyroid crisis, but that the mortality of this condition can be definitely diminished if they be employed as emergency measures against the impending occurrence of such a state

FRANK H. LAHEY

# MASTER SURGEONS OF AMERICA

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## THEODORE A McGRAW

THEODORE ANDREWS McGRAW was born in Detroit in 1839, the son of Alexander C and Susanna Walker McGraw. His early education was received in the private school of Mr. Bacon and the public schools of Detroit until 1858 when he entered the University of Michigan. There were, at that time, no high schools and the universities and colleges were, in his words, "indifferent high schools masquerading under more inspiring names." He found in the University a feature then unique in American schools, a chemical laboratory for students and he afterwards said "I have always regarded it as one of the happiest events of my life that when a student in the University I was influenced by Professor Douglas to enter his laboratory for practical instruction." Undoubtedly his scientific interest was initiated here. He received the degree of bachelor of arts in 1859 and with intention of becoming a lawyer went to Germany in the autumn to begin his studies of jurisprudence in the University of Bonn.

Here he became acquainted with the professor in anatomy and, because of this contact, he began the study of anatomy. His keen interest in this caused him to forsake the law and begin the study of medicine. After two semesters in Bonn he went to Berlin where he continued his studies until 1862. In the meanwhile, the Civil War having broken out, he returned home to support the cause of the North.

Convinced of the advisability of completing his medical studies before enlisting, he entered the College of Physicians and Surgeons in New York and secured the degree of doctor of medicine in 1863. He was shocked at the laxity of method and requirement in the American schools as contrasted with his experience in Germany.

Securing a position as contract surgeon in the Army, he was stationed at Jefferson Barracks in Missouri where one gathers that he was disappointed by the routine character of the work and in three months he entered active service as assistant surgeon with the rank of first lieutenant. From this time until the end of the war his service was active and stirring. First in charge of a surgical ward in the hospital in Chattanooga, then of a smallpox hospital from which he viewed the Battle of Lookout Mountain, later, on the staff of General J. H. Wilson he rode with him on a raid through Alabama. Left behind to care for some wounded, he was captured by General Forrest but was soon released on parole. The war



THEODORE A MCGRAW  
1839-1921

His success in teaching is attested by the large number of able men who secured their early training and enthusiasm at his hands and by the almost idolatrous worship they had for him. He always preached longer and more careful training for surgeons and condemned the attempt to operate without sufficient training and education. This attitude is best expressed in his own words "Modern methods of surgery admit of such radical procedures that the young surgeon is inclined to lose respect for the human body. He thinks he can cut at will and produce sweeping cures immediately. Special equipment should be required of the surgeon. The young graduate in medicine should not be permitted to exercise his zeal for operating until he has perfected himself through older men. I believe a law calling for a special degree would be of value."

In person, plainly but immaculately dressed, dignified and at times austere, but in his personal relations kindly and modest almost to a fault, he was ever sympathetic with the weak but quick to rebuke a wrong. Quiet reigned immediately on his entrance to a lecture room or clinic, and attention born of admiration and respect deepening, in the older students, into affection and love was probably the most notable feature of this association. To those who knew him well it was interesting to note the reaction of the occasional visitor or of one visiting his operative clinic for the first time. After the introductory remarks which always covered with a unique clarity the subject in hand, on picking up the scalpel his hand was seized with a tremor so marked that all unacquainted with him were concerned until the moment the blade came in contact with the operative field, when the firm and steady stroke dispelled the momentary doubt. His operating was marked by care and attention to detail quite in contrast to the spectacular and oftentimes brilliant workers of his time. Lack of consideration of a patient, or an apathetic or slovenly disposal of a case was certain to receive its well merited rebuke. With patients and colleagues alike he was ever the Christian gentleman, ready to give all he had of time, skill, and sympathy.

Following his retirement from active practice and teaching in 1915 he continued a lively interest in surgical literature and progress until his death in 1921 at the age of 82. No one can estimate the amount of good he did surgery by his honesty, inspiration, example, and scientific industry.

FREDERICK A. COLLIER

ending, he left the Army returning to Detroit to take up the practice of his profession

He thus started with a superb equipment, a technical and scientific training far better than usual, and with the initiative and confidence acquired by his varied military experience. Dr McGraw's work in Germany had made him profoundly dissatisfied with American medical schools and in 1869 he, with others, founded the Detroit College of Medicine as a summer school. In 1871 he was invited to the chair of surgery in the University of Michigan which he occupied for one session. Here he found conditions similar to those existing in New York, with the exception of the laboratory work in chemistry. He had enough material for a weekly clinic but no hospital facilities. The endeavors of the faculty to make any change in this regard met with such determined opposition from the politicians that Dr McGraw devoted his entire attention to the Detroit College of Medicine where he was professor of surgery until he retired. After the reorganization of this school in 1885 he became president and dean holding these positions until his retirement in 1915. In speaking of the impulses that led to these activities he says "I had discovered in my two years of army activities that I was deficient in that exact knowledge of anatomy that was essential to good surgery. The advent of antiseptic and aseptic surgery, besides, had opened a new field for operative work, that of the abdomen, which demanded a study of anatomical relations, which had never been taught in the schools. It seemed to me to be imperative, if I were to advance in my profession, that I should have facilities for dissections and other work that can be found only in a medical school."

He thus had the desire for self improvement, to experiment and to teach, and to fulfil this desire he founded a medical school. From the first he was a voluminous writer and one cannot find a volume of the old medical journals as the *Pennsylvanian Journal of Medicine* or *The Physician and Surgeon* without many case reports, clinical papers, and experimental observations from his pen.

He soon became a national figure because of his pioneer work in abdominal surgery, particularly intestinal anastomosis. In 1891, Dr McGraw delivered the chairman's address before the section on surgery and anatomy of the American Medical Association upon "The Use of the Elastic Ligature in the Surgery of the Intestines" and his reputation became international. This work was no happy chance but was the result of several years of painstaking experimental work carried on with his assistants Hickey, Ives, Ireland, and Warren.

His writings show a wide acquaintance with scientific literature and a protean interest in surgery. Hardly a subject of surgery but what was illuminated by him, especially one notes his interest in cancer and intestinal obstruction. As an instance of his daring pioneer surgery, one recalls that he performed in 1882 one of the early thyroidectomies in this country. The patient afterward developed myxœdema which was a source of much chagrin to Dr McGraw.

# IOANNIS MANARDI

MEDICI FERRARIENSIS, HAC AETATE

omnium medicinarum professorum per uniuersam Italiam,  
in Galeni doctrina & Arabum censura  
celeberrimi, & optime

meriti,

EPISTOLARVM Medicinalium  
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*Hi partim inserti in locis ex ab ipso autore iam rectius castigatis  
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# THE SURGEON'S LIBRARY

## OLD MASTERPIECES IN SURGERY

ALFRED BROWN M.D. F.A.C.S. OMAHA, NEBRASKA

### THE LETTERS OF JOHANNUS MANARDUS

THE fame of a prominent physician of the early sixteenth century, especially if he was a professor in a well known school spread far and wide. Consequently his knowledge and skill were often called for but as distances were long and travel slow, it was difficult for him to attend in person and the practice of writing for opinions became quite common. The attending physician wrote a description of his patient's symptoms and inquired as to the diagnosis and treatment, hoping for an answer which would help him in his difficulty.

Joannus Manardus was often appealed to in this way and carried on a large and widely spread correspondence. These letters he saved and subsequently published. The first collection under the title *Medical Letters* appeared in 1521. In 1535 he published a larger collection *Fifteen Books of Medical Letters* by Joannus Manardus Physician of Ferrara at this time the most celebrated and learned in the doctrines of Galen and opinions of the Arabians of all the professors of Medicine in the whole of Italy. In part these are now corrected in many places by the author himself in part now first published. There are added the annotations and criticisms of the simple and compound medicaments of Mesue. Basle 1535. A final collection consisting of twenty books appeared in 1540 and was republished as late as 1611.

The letters appearing in the collection of eighteen books were written between 1500, when he was living in Mirandola and serving as physician to Prince Giovanni Francisco Iico and 1534 when he lived in Ferrara where he had succeeded Nicola Leoniceo in the University.

Though Manardus wrote a commentary on Galen which was first published in 1525 at Rome and republished 11 years later at Basle his letters are his most important contribution to medicine and to a lesser extent to surgery. They give an intimate picture of the man and his ideas for he seldom held to the matter at hand alone but elaborated as he went on giving his opinions on many subjects usually expressed clearly and frequently contrary to the prevalent dicta of the times. He lived during a period of the utmost standpatism in science. There was the greatest respect for the ideas of the ancients and their authority was considered incontrovertible. Yet Manardus places the results of observation

above the authority of Hippocrates Galen and the Arabians and in his opening letter written in 1518 to Florianus Montinus gives his reasons for publishing the letters and states this belief forcefully and without equivocation. He thus marks himself as a pioneer among the physicians of this early sixteenth century in discarding the dicta of tradition and initiating the revolt which was to lead to the renaissance of surgery. Not content with this revolt against established custom in science he again breaks away this time in another direction. In a period ruled by mysticism and superstition and a belief in the influence of stars over the human race when astrologers were among the most influential servants of the crown because the mind of man wished if it dared almost to go back to the gods of Olympus sacrifice to them and consult the Oracle of Delphi—reading its omens in the entrails of the sacrificial beasts yet because of its so called intelligence, hardly daring to go to quite such lengths it must perforce content itself with reading omens in the stars casting horoscopes and attempting to cure disease with charms and amulets. Manardus comes forward with the statement. It is well therefore both for themselves and the sick if the physicians take counsel how often the evacuation is seen in spect urine rather than a star, and observe rather the pulsation of the vein than the configuration of the stars.

Manardus was evidently considered an authority on surgical matters for he writes in answer to questions concerning wounds of the head where he makes a distinction between death due to a wound without fracture and death due to inter-current disease the various types of wounds and fractures congenital dislocation of the hip tumor of the uterus renal and vesical stone and bleeding. From his answers he must be considered rather a surgical pathologist than an operator for though he describes the symptoms and types of surgical conditions he rarely advises operative therapy. Possibly his most important contribution to surgical nomenclature and diagnosis is his bald statement calling attention to the error of Serenus Sammonicus who had taught that elephantiasis and lepra were related to one another. He says. Also one cannot keep silent concerning the error of many following Simon where he has stated that elephantiasis is a form of leprosy, when they are diseases greatly dissimilar. This alone, stamps him as a good clinical observer.

## REVIEWS OF NEW BOOKS

**A HANDBOOK for the Diabetic**<sup>1</sup> is a new addition to the considerable number of acceptable guides for the use of diabetic patients and may be recommended as one of the best available. Intended for the use of the patient and dietitian as well as the physician, the presentation of the material is admirably clear and concise. The value of general routine yearly examinations in the recognition of diabetes is stressed. Emphasis is laid on the necessity of including in the diet sufficient vitamins and mineral content and the amounts believed to be present in each food are included in the table of food analysis.

WALTER H. NADLER

**THREE** further volumes of the *Lewis Practice of Surgery*<sup>2</sup> are offered for review. Volume 1 deals exclusively with miscellaneous surgical topics such as diagnostic methods, anesthesia, wounds, hemorrhage, shock, diet, and the like, all of which are well covered. The chapter on surgical infections by Martin is a classical essay and deserves special comment. The thoroughly fundamental and scientific nature of this article marks a step distinctly forward for the clinician. If we expect to improve upon our present methods of treatment of the surgical infections it must be through the channels of more careful study of the underlying basic factors and the reaction of tissues to the invading organism as well as a study of the physiology and chemistry of the bacteria concerned. Attention should also be called to Hughson's two chapters on pre-operative preparation and postoperative care of the surgical patient. Although comparatively brief these two articles breathe sincerity and enthusiasm. This phase of surgery needs to be elaborated upon because here one single factor may be the keynote to success or the cause for failure. In the preface of his book on *Fundamentals of the Art of Surgery* John H. Watson states—The more one sees of practical surgery the more is one impressed by the relative frequency of unforeseen complications and when one carefully thinks out the cause of these troubles it is only to find that most of them could be prevented. This significant fact is too often so tragically demonstrated when patients receive inefficient pre-operative preparation and postoperative care.

Volumes 10 and 11 are devoted to gynecology and are prepared by a number of well known gynecologists under the very able editorship of Cullen. The diseases peculiar to woman are very well covered but certain chapters have an especial appeal because of the safe, sane and practical attitude of the authors. This is exemplified by C. Jeff Miller's chapter on puerperal infection. This treacherous malady is a

most important subject for the obstetrician and the general practitioner as well as for the abdominal surgeon. It is therefore pleasing and profitable to read this unusually lucid and scientifically sound treatise written by a man who has had a vast experience tempered by good judgment and acumen. The chapters by Martzloff on cervix uteri and by Gardner on ovarian tumors are very well written and complete. It is interesting to note the conservative attitude of King writing on organotherapy. His position is well taken for he stands on the side of fairly definitely proved therapy.

The abdominal surgeon would like to know more about endometrial implants in the bowel wall. This process is not infrequently the cause of incomplete intestinal obstruction and due to its gross characteristics it is often confused with carcinoma on the operating table. In many instances it is possible to make a tentative diagnosis before the operation and the surgeon is then not led astray at the operation. There is grave doubt as to whether the subject will find its way into the system through any other channels except the gynecological.

In volume 11 the chapter by Hunner on right lower abdominal pain should find an inquisitive response. It appears that the right lower quadrant is becoming more of a mystery than is the right upper quadrant. This is because of the rapid development during recent years of the diagnostic procedures with special reference to detecting peptic ulcer, gall bladder, pancreatic, and duodenal disease. More study must be directed toward the right colon.

The two volumes cover the subject of gynecology in a complete and practical manner. The illustrations many by Brudel are excellent. These volumes are fit companions for volume 2 which was reviewed in June 1928.

JOHN A. WOLFE

**OF** distinct interest especially in those countries where the application of biological standards has only recently become a legal obligation is Dr. Burn's new book<sup>3</sup> on methods of biological assay. It will be of value as a reference work in connection with the next revision of the pharmacopoeia and in the adoption of international standards by the Health Section of the League of Nations. He gives detailed descriptions of methods used for the digitalis group, pituitary extract, insulin, arsenobenzene, ergot, adrenalin, ovarian hormone, parathyroid extract, and he mentions more briefly methods applicable to thyroid extract, atropine, and anterior lobe of the pituitary.

The reader cannot help but be impressed with the degree of care and skill and the corresponding expense in materials that are necessary to insure the

<sup>1</sup> *A HANDBOOK FOR THE DIABETIC*. By ALAN H. R. W. B. S. M. S. (Camb.) New York and London: Oxford University Press, 1928.

<sup>2</sup> *PRACTICE OF SURGERY*. Edited by D. and L. Lewis, M.D. Sc.D. Vol. I—General Surgery. Vols. II and III—Gynecology. Hagerstown, Maryland: W. B. Prior Company, Inc., 1928.

<sup>3</sup> *METHODS OF BIOLOGICAL ASSAY*. By J. H. Burn, M.A. M.D. (Camb.) With an Introduction by H. H. Dale, C.B.E. R.S. M.D. F.R.C.P. New York and London: Oxford University Press, 1928.



a drawback as might be expected because of the profuse illustrations. However the reviewer is glad to note that the book will be speedily translated.

The reviewer considers the work of Sicard and Forestier as among the most important advances contributed to medicine in recent years and therefore, this book is one which has not only practical but historic interest. R B B

**N**EW installments of *Biology and Pathology of Woman* edited by Halban and Seitz have been appearing in a steady succession throughout the last year, and the gigantic work will soon be before us in its entirety.

The multifarious clinical aspect of uterine fibroids is presented by Albrecht in an essay of 149 pages. Among the well known symptoms, menorrhagia and metrorrhagia are the most common and important signs. Postclimacteric bleeding may in rare cases be caused by harmless polyps but more often it is due to a coexistent carcinoma or a sarcomatous degeneration of one or more of the fibroids. Disturbances of the heart or the metabolism, changes in the thyroid or the development of constitutional anomalies are often attributed to the uterine tumors. Albrecht warns against an uncritical acceptance of such statements. He points out that in the fourth and fifth decades of life all these alterations are quite as common in women without fibroids and he is inclined to believe that in patients with fibroids the combination may be purely accidental. The harmful effect of fibroids on the heart in particular is far from being proved. Valvular lesions are always caused by factors other than fibroids. Myocarditis can be considered secondary to fibroids only if the tumors are very large (brown atrophy) or the anemia most pronounced (fatty degeneration). Cardiac dilatation is merely the result of anemia and may correct itself after the bleeding has been checked permanently. In functional disorders of the heart the connection with fibroids has not been established; it would be more permissible to seek the connection in a dysfunction of the ovaries. The frequent rise in blood pressure bears, likewise, no regular relation to fibroids, and it is noteworthy that it usually remains high after the elimination of the tumors or uterus. The interesting though scant literature on hereditary transmission of fibroids is discussed as is also the question of fibroids and fertility.

Of the section on diagnosis only the data on necrosis of fibroids in pregnancy and puerperium may here be mentioned. In this complication which manifests itself by signs of peritoneal irritation and fever the author advises early operation rather than waiting until chills and progressive peritonitis indicate infection and presage a very doubtful prognosis.

As to the question when to operate and when to use radium in the treatment of fibroids Albrecht

professes views very similar to those enunciated by the reviewer<sup>1</sup> to which the author also refers in the bibliography. This bibliography by the way covers many pages of fine print and contains numerous references from American literature. While surgical therapy is given a wide field yet the fact that there is an operative mortality of at least 3 per cent must warn us against careless indications. Discussing the *pros* and *cons* of supravaginal amputation the author considers the chance of carcinomatous degeneration of the cervical stump as practically negligible. With this statement the reviewer from a fairly extensive personal experience, cannot agree. It is however the only statement which he would question, for this treatise is an admirable piece of literary work which far transcends the limits of a textbook article and delves deeply into all phases of a subject of immense practical importance.

The discussion of treatment of fibroids is continued by V. Seuffert who attacks the subject from the standpoint of the gynecological radiologist. The author whose excellent textbook on deep radiotherapy in gynecology was reviewed in this journal some 6 years ago considers both fibroids and non malignant hemorrhages. He gives credit to Wickham of New York who in 1906, was the first to use radium for climacteric bleeding. The dosage the safety the indications and contra indications the effects and by effects and finally, the technique are some of the subheadings of this contribution which gives to the reader a very good survey of this burning question. The author does not believe that the germ plasma can be injured by properly applied X ray or radium treatment but warns against the use of these agents after conception has taken place. He expresses himself with due caution as to whether or not radiation is suitable for the relief of sterility, an attitude with which most gynecologists will be in full accord.

The same installment contains an article again from the pen of Albrecht on the pathology and clinical aspect of sarcoma of the uterus. Contrary to exaggerated estimates sarcomatous degeneration of fibroids takes place only in about 1 per cent. Its frequency compared with that of carcinoma is 1 in 30 or 1 in 50. After a description of the macroscopic and microscopic characteristics of sarcomata the question of the most promising treatment is discussed. Unfortunately neither surgery nor radiation yield encouraging results. Bv and large deep X ray therapy is perhaps, a little better since it is at least not encumbered with any operative mortality. On the other hand diffuse formation of metastases seems to follow this form of treatment all too quickly.

Lahm contributes three chapters on the histopathology of mixed tumors (lipoma myxoma angioma etc.) adenoma and carcinoma of the uterus respectively. These chapters which are not suited for detailed reviewing, are illustrated with

1 BIOLOGIE UND PATHOLOGIE DES WEIBES. EIN HANDBUCH DER FRAUENHEILKUNDE. ZWÖLFTE AUFLAGE. Edited by Josef Halban and Ludwig Seitz. 4 Bände. 7 39 38 39 40 41 42. Berlin and Vienna. Urban & Schwarzenberg. 1923. 1929.

purity and potency of the drugs the physician uses. There is an admirable introductory chapter by H. H. Dale on the general subject of biological standardization. C. A. DRACOSTEY

THIS book of 661 pages on proctology<sup>1</sup> is highly recommended to those interested in the subject. Wide clinical experience and knowledge of pathological anatomy are everywhere in evidence in the text. The illustrations are numerous (417 in number) and well done. Obsolete procedures such as division of the valves of Houston for constipation are mentioned to be condemned. The treatment of the various lesions in the rectum is somewhat encyclopedic and the author's personal preference in the matter is not emphasized as much as this reader would have liked. The chapter on structure of the rectum is excellent. The treatment of internal hemorrhoids by injection is taken up in some detail. The author states that only 50 per cent are amenable to treatment and that 'symptomatic relief and more or less permanent cure results the parts being left in a healthy condition and functioning normally.' My feeling is that in the great majority of cases the treatment is purely palliative and in the hands of an inexperienced man results in frequent and occasionally serious complications. In the chapter on coccygodynia the importance of osteoarthritis of the lower elements of the spine could properly have been emphasized.

From a surgical standpoint this book is sound and should receive a wide circulation. V. C. D.

THE title *Röntgenology, its Early History, Some Basic Physical Principles and the Protective Measures*<sup>2</sup> implies a work or treatise covering the subject of roentgenology. The title is misleading inasmuch as it deals only with a few phases of X-ray knowledge and is really an elaboration of the author's Caldwell lecture delivered in 1927 before the American Roentgen Ray Society. To this has been added material on certain phases of the physics of X-rays and some practical material regarding X-ray protection.

The first chapter of the book is a most interesting though somewhat brief exposition of the history of events which led up to the discovery of the X-ray by Roentgen in 1895. In another chapter the nature of X-ray is discussed and is ably presented with numerous references to the works of investigators who have contributed to the knowledge of the physics of radiation. The subject is brought up to date and sets forth the experimental findings and results obtained by modern physicists among them in America being Millikan and Compton.

The author gives considerable space to the matter of X-ray protection. The regulation of various

civic bodies on X-ray laboratory installations and requirement of government regulatory bodies are detailed and recommendations are set forth which are of particular value to architects and constructors of our modern hospitals. Protection against undesired effects of radium to workers in this element is also considered.

In an appendix the author gives the official recommendations of the British X-ray and Radium Protection Committee, and a similar set of recommendations adopted by the second International Congress of Radiology in Stockholm in 1928 is presented.

The book contains much useful information for the student in X-ray physics. One might suggest that a more appropriate title could have been given this book, one that would be more specific of its contents than the broad and inconclusive term used which gives the impression of a wider and more general consideration of the subject than it actually contains. E. S. B.

SICARD and Forestier have rendered a tremendous service to the medical profession by the introduction of lipiodol as an aid to diagnosis. New uses for it are being continually found and nowadays in many instances, in which the X-ray can be used as an aid to diagnosis of hollow cavities or vessels, etc., offers great assistance.

In their book *The Use of Lipiodol in Diagnosis and Therapeutics*<sup>3</sup> the authors discuss their own observations and those of others. Individual chapters are devoted to the use of lipiodol in diagnosis of lesions of the spinal cord and subarachnoidal spaces of the tracheo-bronchial tree, of the genito-urinary apparatus and to the exploration of blood vessels, abscesses and fistulae, paranasal sinuses, lacrimal systems, and stomach and to such miscellaneous conditions as salivary glands, bones, joints, etc. In the chapter devoted to therapy the therapeutic use of lipiodol in the epidural spaces in certain joint conditions, in suppurative lesions of the bronchial tree, in cold abscess, etc., are discussed.

A very complete bibliography is appended.

The general construction of the book is excellent. The descriptions are clear and concise. Whenever a method of technique is described it is done so in such a way that it can be very easily followed. The book is profusely illustrated with excellent X-ray reproductions showing phases of most of the important variations normal and pathological.

Every roentgenologist will want this book for his library if he has not already the original articles. However, it is not to the roentgenologists but to the profession in general that this book most appeals. Inasmuch as the use of lipiodol may be of diagnostic aid in almost every branch of medicine and surgery as indicated by the titles of the chapters, this book will interest men working in many fields. The fact that it is written in a foreign language is not as great

<sup>1</sup> PROCTOLOGY. A TREATISE ON THE MALFORMATIONS, INJURIES AND DISEASES OF THE RECTUM, A URS AND PERINEAL COLON. By F. H. C. YOUNG. M.D., M.D., F.A.C.S. New York: D. Appleton and Company, 1929.

<sup>2</sup> RÖNTGENOLOGY, ITS EARLY HISTORY, SOME BASIC PHYSICAL PRINCIPLES AND THE PROTECTIVE MEASURES. By G. W. C. KAUF, O.B.E. M.A., D.Sc., F.Inst.P. New York: Paul B. Hoeber, Inc., 1928.

<sup>3</sup> DIAGNOSTIC ET THÉRAPEUTIQUE PAR LE LIPIODOL. CHENET ET FÉLIX. RADIOLÓGIE. By J. A. Sicard and J. Forestier. Paris: Masson et Co., 1928.

throughout, all known facts are logically correlated, and there has been a most successful attempt to eliminate old surgical barnacles. As a quick reference series or a vade mecum for younger surgeons who have, at least, a working knowledge of the French language these volumes can be heartily recommended. They represent the best thoughts of French surgeons. Each subject is treated under identical subheads, i.e. etiology, pathologic anatomy, symptoms, and diagnosis and treatment. The index is admirable. Volume 1 deals with general surgical pathology and diseases of tissues in general. Modern ideas of biology, biochemistry, and physiology are tersely brought out. Volume 2 is devoted to surgical diseases of the head, brain and spinal cord. Volume 3 includes the neck, thorax and mammary glands. Volume 4 is entirely devoted to surgery of the abdominal contents. Volume 5 discusses male genitalia, the genito-urinary tract and general gynecology. The final volume is entirely reserved to the treatment of fractures.

The only criticism which can be justly made is to accuse the authors of being not infrequently too intensely nationalistic. Very few 'foreign' contributions are mentioned. The six volumes represent the present day opinions of French surgeons almost exclusively based on experimental or clinical observations of French coworkers. One is somewhat startled for instance to find that in the chapter on inguinal hernia the name of E. W. Wylls Andrews is not mentioned! Many other omissions can be noted and one can only hope that some day the classical dictum of French teachers to their students to 'opérer à la Française' may be replaced by a more international viewpoint. GEORGE DE TARNSKY

THERE is an abundance of facts in the little volume on *The Causes of Ante Natal, Natal and Neo Natal Mortality of Infants with Special Reference to South India*. Since statistics in India are difficult to obtain those put forth in this volume are valuable in throwing light on obstetrical conditions in Madras. It is interesting to note that one third of the births take place in the hospital.

The maternal mortality rate is close to two and one half per cent in the two hospitals studied. This of course is quite high but the author gives the inference that undernourishment is a factor. This explains some of the mortality in infants as many are born prematurely.

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section should cloud the judgment, and not forceps operation or version and extraction, is hard to understand.

It is interesting to note that in 64,000 confinements there were 2 cases in the 12th year, 18 in the 13th, 87 in the 14th and 307 in the 15th year. While "early maternity" does occur it is not as common as a recent lay publication would lead us to believe.

This booklet is well worth reading.

EDWARD L. CORNELL M.D.

ROBINSON and Jameson's *Surface Anatomy*,<sup>2</sup> as its preface states is intended for the student dissector. When used along with the systemic anatomy and dissector as collateral reading there is probably no book now published which approaches it in excellence. Certainly, for thoroughness in material presented and for clearness of presentation it ranks with the best in topical anatomy. No attempt has been made to include clinical applications of the relationships presented and while the addition of practical applications might enhance the book for the surgeon, opinions differ as to their value to the beginning medical student. The book differs somewhat from the usual exposition of surface anatomy in that each region is taken up systematically so that each structure is described in its entirety and in continuity getting away from the confusing cross sectional manner of presenting surface relations. The 38 illustrations are well chosen but it is felt that a number more could be added to advantage. The absence of any but incidental reference to the genital organs is unique. The book will find its greatest use in the dissecting room though it would doubtless be a valuable reference text for the clinical teacher in courses of physical diagnosis. MICHAEL L. MASON

THE recent publication by *Pauchet and Dupret*<sup>3</sup> is a pocket atlas in size only for actually it contains 297 excellent diagrammatic plates which illustrate surprisingly well the whole of human anatomy. The plates are arranged by regions so that ready reference to any structure is quite easy. There is no descriptive text and the figures are labeled directly on the plate without the necessity of referring to legends. The last 21 illustrations of lymphatic drainage present in a clear and non confusing manner the main pathways with which the surgeon is concerned. It is believed by the reviewer that the addition of several plates would increase the value of a new edition. These plates might well include a more detailed and larger diagram of the inguinal region with reference to hernial repair, a plate of the abdominal wall to show the muscular layers with reference to the usual incisions, illustrations of the fascial spaces of the shoulder axilla and hand and a series of sectional views of the joints. A diagrammatic view of the

THE CAUSE OF ANTE NATAL, NATAL AND NEO-NATAL MORTALITY OF INFANTS WITH SPECIAL REFERENCE TO SOUTH INDIA. BY THE EDITOR, ANTHE NATAL LECTURES HELD UNDER THE AUSPICES OF THE LONDON CITY OF MADRAS AT THE GIFFORD SCHOOL OF OBSTETRICS. BY A. LAKSHMI. 440 pp. M. 10/- B. 4/- M. 12/- Associated Press 1918

<sup>2</sup> OXFORD MEDICAL PUBLICATIONS. SURFACE ANATOMY. BY A. THUR ROBERTSON M.D. F.R.C.S. and E. B. JAMESON M.D. New York: William Wood and Company 1918

<sup>3</sup> OXFORD MEDICAL PUBLICATIONS. POCKET ATLAS OF ANATOMY. BY VICTOR PAUCHET and S. DUPRET. New York: William Wood and Company 1920

numerous photomicrographs and reflect the wide experience of the well known author who is one of the leaders among the younger German gynecological pathologists. They furnish an excellent basis for a thorough study of the conditions named.

There follows a chapter in which Kermanner deals with the clinical aspect and the operative treatment of the various forms of cancer of the uterus and another chapter which Eymers devoted to radiotherapy of uterine cancer. The presentation of these subjects is so complete that the reader, who has some experience of his own is enabled to draw his own conclusions in a matter which is still in the center of discussion.

Turning at random to another installment we find a monograph on the biology and pathology of pregnancy and labor in domesticated animals written by Keller. The inclusion of this subject in the great reference work has obvious advantages. It represents a bridge between human and veterinary medicine across which fruitful suggestions can be exchanged. The modern gynecologist for whom this work has been created, will widen his biological horizon by learning of normal and deranged functions of reproduction in animals, and one who contemplates animal experimentation can save much time and effort by studying this essay of a recognized authority.

Latzko and Schiffmann fill an entire installment with an essay on the relations of the urinary apparatus to the female generative organs. This contribution with its 355 pages 67 illustrations and 8 colored plates represents a complete textbook on gynecological urology. Kolischer of Chicago was the pioneer in this field. Methods of examination and diagnosis form the first part. Then follow diseases of the female urethra. Of these stricture is considered more frequent by American than by German authors. In the extensive section on diseases of the bladder the special significance of this organ in the field of obstetrics and of gynecology is given due prominence. The authors show how much the surgery of the ureters has been improved by gynecologists. It may be questioned whether the detailed presentation of anomalies and diseases of the kidney (almost 100 pages) rightly belongs in a gynecological work. Much of it should be reserved for the urologic specialist. On the other hand problems of differential diagnosis the question of pyelitis in pregnancy, gestation after nephrectomy, hypernephromatous metastases within the genital sphere etc. directly concern the gynecologist. From this point of view the inclusion of the various kidney lesions is of definite value to us. It may be mentioned incidentally that the American literature is very fully considered in this contribution.

Other borderline subjects are taken up by Novak. There is for instance an article on the relations between the eye, ear, nose, and throat and the genitals, another on the reciprocity with muscles, bones and the gastro intestinal tract, a third on infectious diseases, still others on the nervous system and the

skin in their relations to the female generative sphere. One is amazed at the thoroughness and encyclopedic knowledge of the author who has collected scattered reports from all the world and welded them into compact presentations of the respective subjects under discussion. Let me select, as an illustration his chapter on the interrelations of skin and female genitals. It has 89 pages with 11 pages of bibliography and numerous excellent photographs in natural colors and in black and white. I began by glancing at it as a subject little known to me and ended only after I had read every word most attentively. I found the study of absorbing interest and full of suggestions as to further practical investigations and I believe that this will be the reaction of most other readers who like myself, have been all too much immersed in mere organ pathology.

This review may be closed with a brief reference to the admirable article by Neurath on the physiology and pathology of puberty. This important phase in the development of woman has thus far not received a monographic consideration. The author presents instructive tables illustrating the time of first menstruation, the growth and development of the body as a whole and of the various organs and tissues. A comparison between boys and girls shows that at the age of 8 to 10 boys on an average are taller and heavier than girls. Toward the end of the tenth year, girls take the lead both as to height and weight, but after the fifteenth year they are again exceeded by boys and from then on remain permanently below them. Body growth ceases when sexual maturity is complete, that is in man at 23 in woman at 18 years. Pigmentation of the skin bears some relation to puberty. Certain tribes extirpate the ovaries in their young girls in these the perineum, anal region and axillæ remain white (This fits in with the observation of kraurosis in young women with insufficiency of the ovaries). The chapter on the development of the psyche in puberty is beautifully written and deepens our understanding of the adolescent girl. Of the general pathology, morbidities, and mortality of puberty only precocious puberty may here be mentioned, the relation of girls to boys in this connection is 335 to 1.

The storm and stress period of puberty is as a rule, little understood by parents and educators and the physician is often consulted for manifestations which may be wholly physiological. The study of this essay will help him to act as a sympathetic friend and adviser.

GEORGE GELLHORN

THE volumes included in *Précis de Pathologie Chirurgicale*<sup>2</sup> constitute the official 'Quiz' compends used by members of the French faculties of medicine preparatory to their examinations for professorship. The same terse sentences are used

1 PAFICIDE PATHOLOGIE CHIRURGICALE V 1 et 4 By P B gou  
F P p n H nri Bou geol Pierr Dav t J G tellier A Gosset 11  
Petit Datalis E Je brau P Lecene Ch Leno m et R Prou t  
R S pault L Tim and M Patel 5th ed compl tely rev Paris  
Masso et Cie 1935

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EDWARD L. CORNELL, M.D.

ROBINSON and Jameson's *Surface Anatomy*,<sup>2</sup> as its preface states, is intended for the student dissector. When used along with the systemic anatomy and dissector as collateral reading there is probably no book now published which approaches it in excellence. Certainly for thoroughness in material presented and for clearness of presentation it ranks with the best in topical anatomy. No attempt has been made to include clinical applications of the relationships presented and while the addition of practical applications might enhance the book for the surgeon, opinions differ as to their value to the beginning medical student. The book differs somewhat from the usual exposition of surface anatomy in that each region is taken up systematically so that each structure is described in its entirety and in continuity, getting away from the confusing cross sectional manner of presenting surface relations. The 38 illustrations are well chosen, but it is felt that a number more could be added to advantage. The absence of any but incidental reference to the genital organs is unique. The book will find its greatest use in the dissecting room though it would doubtless be a valuable reference text for the clinical teacher in courses of physical diagnosis. MICHAEL L. MASON

THE recent publication by *Pauchet and Dupret*<sup>3</sup> is a pocket atlas in size only for actually it contains 207 excellent diagrammatic plates which illustrate surprisingly well the whole of human anatomy. The plates are arranged by regions so that ready reference to any structure is quite easy. There is no descriptive text and the figures are labeled directly on the plate without the necessity of referring to legends. The last 11 illustrations of lymphatic drainage present in a clear and non confusing manner the main pathways with which the surgeon is concerned. It is believed by the reviewer that the addition of several plates would increase the value of a new edition. These plates might well include a more detailed and larger diagram of the inguinal region with reference to hernial repair, a plate of the abdominal wall to show the muscular layers with reference to the usual incisions, illustrations of the fascial spaces of the shoulder, axilla, and hand and a series of sectional views of the joints. A diagrammatic view of the

<sup>1</sup> THE CAUSES OF ANTE NATAL, NATAL AND NEO-NATAL MORTALITY OF INFANTS, WITH SPECIAL REFERENCE TO SOUTH INDIA. BEING THE ELIZABETH MATHAI LECTURES DELIVERED UNDER THE AUSPICES OF THE UNIVERSITY OF MADRAS AT THE GOVERNMENT SCHOOL OF OBSTETRICS, BY A. KARAYANANDAN, M.D., M.B., B.A., M.D., Madras. Associated Printers 1918.

OXFORD MEDICAL PUBLICATIONS. SURFACE ANATOMY. By Arthur R. BRIDGES, M.D., F.R.C.S., and E. B. JAMESON, M.D. New York: William Wood and Company, 1918.

OXFORD MEDICAL PUBLICATIONS. POCKET ATLAS OF ANATOMY. By Victor PAUCHET and S. DUPRET. New York: William Wood and Company, 1919.



entire urinary tract from prostate to kidney would also be valuable. The book can be sincerely recommended as a rapid reference atlas which would

always be most welcome in the surgeon's dressing locker where it could be consulted in a few moments

MICHAEL L. MASON

## BOOKS RECEIVED

Books received are acknowledged in this department and such acknowledgment must be regarded as a sufficient return for the courtesy of the sender. Selections will be made for review in the interests of our readers and as space permits.

**THE ORIGIN OF MALIGNANT TUMORS** By Theodor Boveri. Translated by Marcella Boveri. Baltimore: The Williams and Wilkins Company 1929.

**NEW AND NONOFFICIAL REPHRASES 1929** Containing Descriptions of the Articles which Stand Accepted by the Council on Pharmacy and Chemistry of the American Medical Association on January 1, 1929. Chicago: American Medical Association 1929.

**THE SCIENCE AND PRACTICE OF SURGERY** By W. H. C. Romanis, M.A., M.B. M.Ch. (Cantab.) F.R.C.S. (Eng.) F.R.S. (Edin.) and Philip H. Mitchiner, M.D., M.S. (Lond.) F.R.C.S. (Eng.). Vol. 1 and 2. 2d ed. New York: William Wood and Company 1929.

**TWEEDY'S PRACTICAL OBSTETRICS** Edited and largely rewritten by Bethel Solomons, M.D. F.R.C.I. M.R.I.A. 6th ed. New York: Oxford University Press 1929.

**GONORRHEA AND KINDRED AFFECTIONS, GONORRHEA IN THE MALE, CHANCROID AND VERRUCA ACUMINATA** By George Robert on Livermore, M.D. F.A.C.S. and Gonorrhea in the Female and the Infectious Granulomata By Edward Armin Schumann, A.B. M.D. I.A.C.S. New York and London: D. Appleton and Company 1929.

**PRINCIPLES AND PRACTICE OF MINOR SURGERY: A TEXTBOOK FOR STUDENTS AND PRACTITIONERS** By Edward Milton Foote, A.M., M.D. and Edward Meakin Livingston, B.Sc., M.D. 6th ed. New York and London: D. Appleton and Company 1929.

**A HISTORY OF THE MEDICAL DEPARTMENT OF THE UNITED STATES ARMY** By P. M. Ashburn, Colonel Medical Corps, U. S. Army, with an Introduction by Surgeon General Merritt W. Ireland. Boston and New York: Houghton Mifflin Company. The River Side Press, Cambridge 1929.

**GYNECOLOGIE GYNÉCOLOGIQUE ET MÉDECINE DES FEMMES** By Henri Vignes. Paris: Masson et Cie 1929.

**MEDIZINISCHE PRAXIS** Vol. VI: ABRASION UND PROEXSION IN DER HAND DES PRAKTIISCHEN ARZTES By Prof. Dr. Wilhelm Labbe. Dresden and Leipzig: Theodor Steinkopff 1929.

**DIE GASTROSKOPIE IM RAHMEN DER KLINISCHEN MAGENDIAGNOSTIK** By Dr. Kurt Gutzeit. Berlin: Julius Springer 1929.

**INTERNATIONAL CLINICS**, a Quarterly of Illustrated Clinical Lectures and Especially Prepared Original Articles on Treatment, Medicine, Surgery, etc. Edited by Henry W. Cattell, A.M., M.D. with the collaboration of others. Vol. 11. Thirty-ninth Series 1929. Philadelphia and London: J. B. Lippincott Company 1929.

**METHODS AND PROBLEMS OF MEDICAL EDUCATION** (Twelfth Series) New York: Rockefeller Foundation 1929.

**THE MEDICAL DEPARTMENT OF THE UNITED STATES ARMY IN THE WORLD WAR** Vol. 11: Finance and Supply. Prepared under the direction of Maj. Gen. M. W. Ireland.

**The Surgeon General** by Col. Edwin P. Wolfe, M.C. Washington: U. S. Government Printing Office 1928.

**THE NOSE, THROAT AND EAR AND THEIR DISEASES. IN ORIGINAL CONTRIBUTIONS BY AMERICAN AND EUROPEAN AUTHORS** Edited by Chevalier Jackson, M.D., Sc.D. J.L.D. F.A.C.S. and George Morrison Cortes, A.B. M.D. F.A.C.S. Philadelphia and London: W. B. Saunders Company 1929.

**PRINCIPLES AND PRACTICE OF ELECTROCARDIOGRAPHY** By Carl J. Wiggers, M.D. St. Louis: The C. V. Mosby Company 1929.

**OSTEOMYELITIS AND COMPOUND FRACTURES AND OTHER INFECTED WOUNDS: TREATMENT BY THE METHOD OF DRAINAGE AND REST** By H. Winnett Orr, M.D. F.A.C.S. St. Louis: The C. V. Mosby Company 1929.

**THE CONQUEST OF CANCER BY RADIUM AND OTHER METHODS** By Daniel Thomas Quigley, M.D. F.A.C.S. Philadelphia: F. A. Davis Company 1929.

**COLLECTED PAPERS OF THE MAYO CLINIC AND THE MAYO FOUNDATION** Edited by Mrs. M. H. Mellish, Richard M. Hewitt, B.A., M.A., M.D. and Mildred A. Feller, R.S. Vol. 11. 1928. Philadelphia and London: W. B. Saunders Company 1929.

**OTOSCLEROSIS: A REVIEW OF THE LITERATURE TO JULY 1928 COMPILED UNDER THE DIRECTION OF THE COMMITTEE ON OTOSCLEROSIS, AMERICAN OTOLOGICAL SOCIETY** By Norval H. Pierce, M.D., James F. McKernon, M.D., Eugene A. Crockett, M.D., J. Gordon Wilson, M.D., Arthur B. Duell, M.D. Editor: Vols. 1 and 2. New York: Paul B. Hoeber, Inc. 1929.

**THE MEDICAL DEPARTMENT OF THE UNITED STATES ARMY IN THE WORLD WAR** Vol. 8: Neuropsychiatry in the United States by Col. Pearce Bailey, M.C., Lieut. Col. Frankwood E. Williams, M.C. and Sergt. Paul O. Komars, M.D. In The American Expeditionary Forces by Col. Thomas W. Salmon, M.C. and Sergt. Norman Fenton, M.D. Prepared under the direction of Maj. Gen. M. W. Ireland. Washington: U. S. Government Printing Office 1929.

**LA RACHIANESTHÉSIE** By André Chahier. Paris: Gaston Doin et Cie 1929.

**THE MEDICAL MUSEUM: MODERN DEVELOPMENTS ORGANISATION AND TECHNICAL METHODS BASED ON A NEW SYSTEM OF VISUAL TEACHING** By S. H. Daikes, O.B.E., M.D., D.P.H., D.T.M. & H. London: The Wellcome Foundation Ltd. 1929.

**GYNECOLOGY: A TEXTBOOK OF THE DISEASES OF WOMEN** By Lynn Lyle Fulkerson, A.B., M.D. F.A.C.S. Philadelphia: P. Blakiston's Son & Company 1929.

**THE HISTORY OF HEMOSTASIS** By Samuel Clark Harvey, M.D. New York: Paul B. Hoeber, Inc. 1929.

**PATHOLOGICAL ANATOMICAL AND CLINICAL INVESTIGATIONS OF FIBRO ADENOMATOSIS, CYSTIC MAMMAE AND ITS RELATION TO OTHER PATHOLOGICAL CONDITIONS IN THE MAMMA, ESPECIALLY CANCER** By Carl Semb. Oslo, Norway: Nationaltrykkeset 1928.

**THE CLINICAL ASPECTS OF VAGUS PRESSURE** By J. A. E. Eyster, B.Sc., M.D. New York: The Macmillan Company 1929.

# AMERICAN COLLEGE OF SURGEONS

## TREATMENT OF MALIGNANT DISEASES WITH RADIUM AND X-RAY

### REPORT OF THE COMMITTEE ON THE TREATMENT OF MALIGNANT DISEASES WITH RADIUM AND X-RAY OF THE AMERICAN COLLEGE OF SURGEONS

ROBERT B. GREENOUGH, M.D., F.A.C.S., BOSTON, CHAIRMAN

#### REPORT NO. II — CANCER OF THE CERVIX

THE accompanying report is that of a committee appointed by the American College of Surgeons in February, 1922, and is supplementary to the first report of that committee on cancer of the cervix of the uterus which was published July, 1924, in SURGERY, GYNECOLOGY AND OBSTETRICS.<sup>1</sup>

The members of the Committee are as follows: A. C. Broders, Rochester, Minnesota; C. F. Burnam, Baltimore; G. W. Crile, Cleveland; Bowman C. Crowell, Chicago; William Duane, Boston; Edwin C. Ernst, St. Louis; J. M. T. Finney, Baltimore; Burton J. Lee, New York; Frank Lynch, San Francisco; R. T. Miller, Jr., Baltimore; H. K. Pancoast, Philadelphia; H. Gideon Wells, Chicago; Francis Carter Wood, New York; and Robert B. Greenough, Boston.

The 1924 report of the Committee on the "Treatment of Cancer of the Cervix" could be carried only to a three year minimum of end results, but at the request of the Board of Regents this report was published with the understanding that a supplementary report on a five year end result basis would be made at a later date. The material which follows represents the data obtained by the Committee for this purpose.

These two reports are based upon 1250 case records collected from the following hospitals: (1) F. C. Hospital for Women, Boston; (2) W. P. Gray's (3) Huntington Hospital, Boston; (4) G. A. Leitch (5) Massachusetts General Hospital, Boston; (6) Lincoln Davenport (4) St. Joseph's Hospital, Chicago; (5) Cook County Hospital, Chicago; (6) Henry Schmitz (10) German American Hospital, Chicago; (7) Post Graduate Hospital, Chicago; (8) St. Mary's Hospital, Chicago; (9) Henry Schmitz (10) St. Joseph's Hospital, Chicago; (10) Henry Schmitz (11) Franklin Boulevard Hospital, Chicago; (12) Roosevelt Hospital, New York; (13) Dr. H. Ward C. T. (14) Lincoln Davenport (15) Philadelphia; (16) John G. Clark (17) Philadelphia General Hospital, Philadelphia; (18) Dr. Chas. P. Norris (19) Scranton Hospital, Scranton, Penn.; (20) Dr. J. M. Wainwright (21) Freyette Hospital, New York; (22) Dr. James A. Corwood (23) Toronto General Hospital, Toronto; (24) Alexander Primmer (25) H. W. D. A. Kelly Hospital, Baltimore; (26) Curtis F. Burnam (27) Jefferson Hospital, Philadelphia; (28) Dr. H. A. Anspaugh (29) Woman's Hospital, New York; (30) Dr. G. W. Gray, Ward (31) Memorial Hospital, New York; (32) Dr. William H. Healy (33) Lake Erie Hospital, Cleveland; (34) Dr. George W. Crile (only one case treated in the years 1924-1929 inclusive).

The 1924 report recorded 94 cases of cancer of the cervix free from evidence of disease for a period of three or more years after treatment. Through the reporters from the various clinics from which the original records were obtained, efforts were made to obtain information in regard to the further history of these patients with the following results: 4 cases recorded as well at 3 years but under 5 years, could not be further traced. One case alive and well at 3 years, died without recurrence before 5 years had elapsed and 2 cases alive and well over 3 years, died subsequently of causes unknown. These cases have been omitted from the series as inconclusive making a total of 7 cases to be deducted from the original 94, leaving 87 cases of the original series to form the basis of this report. It may be stated here that some 16 cases reported "untraced" in 1924 have since been traced and 9 of them found to be alive and well at periods of over 5 years. These cases however are not included in the series as they were not counted in the 1924 report. They include, however, 12 cases of hysterectomy with or without radium, with 7 alive and well over 5 years, 1 case of Percy cauterization well 12 years, 1 case of excision of the cervical stump left after supravaginal hysterectomy well after 5½ years, and 2 cases of radium alone, both failures. Of this total of 87 cases here recorded as alive and well over 5 years, 12 have not been traced since 1924. All of these, however, had then (in 1924) passed a minimum period of 5 years and they have been included in the present series. Sixteen of the 87 cases recorded as alive and well in the 1924 series have died of cancer since that time, and the remaining 71 cases have remained well for varying periods from 5 to 13 years from the date of treatment. These 71 cases

It may be noted that of the 7 cases thus omitted, 4 were treated by hysterectomy alone, 2 by radium alone and one by cautery and ligation of the internal iliacs.

TABLE I—TOTAL RECORDS RECEIVED, REJECTED, AND ACCEPTED FOR STUDY

Total cards received	1,210
Discards first report 1924	
Untraced	159
Not cancer of cervix	10
No treatment	56
No pathological diagnosis	31
Under 3 years	25
Re entries—duplicates	23
1913 and 1920-1921-1922	43
No data to classify	13
Otherwise inconclusive	20
Satisfactory for study 1924	191
Discards second report, 1928	829
Untraced 5 years	4
Died—cause unknown 6 and 7 years after treatment	2
Died without recurrence after 3 and before 5 years	1
Satisfactory for study 1928	7
	822

TABLE II—FIVE YEAR END RESULTS, 1928

1924 report—alive and well over 5 years	94
Deducted as inconclusive—	
Died without recurrence after 3 and before 5 years	1
Died cause unknown well respectively, 6 and 8 years	
Well 3 years untraced after 5 years	4
1924 cures traced 5 years or more	87
Died of cancer after 3 years	16
Alive and well 5 years or more	71
Primary cases alive and well over 5 years after hysterectomy	27
Primary cases alive and well over 5 years after radium without hysterectomy	33
Recurrent cases	11

71

include the following 11 are cases of recurrence after hysterectomy. This includes all of the cases recorded as free from disease in 1924. The remaining 60 are cases of primary cancer of the cervix, 27 of which were treated by hysterectomy, and 33 with radium without hysterectomy.

There were 142 hysterectomies performed in the 681 primary cases of the 1928 report 123 were pan hysterectomies by the Wertheim technique—9 were recorded only as abdominal hysterectomies, in 6 cases only a supravaginal hysterectomy was done and in 4 cases a vaginal hysterectomy was performed. It is to be noted that 2 of the 4 vaginal hysterectomies gave successful 5 year end results, while the remaining 25 successful results from operation were all obtained by the Wertheim pan hysterectomy operation.

It was necessary to reject 381 records of the total number of 1,210 in both the 1924 and the

TABLE III—COMPARISON OF END RESULTS IN 1924 AND 1928

	1924			1928		
Primary cases	Cases	Cures	Per cent	Cases	Cures	Per cent
1A	123	35	28	119	25	21
1B	170	22	13	119	18	15
1C	310	24	8	308	15	5
1D	115	2	1	135	2	1
	688	83	12	681	60	9
Recurrent cases 2 and 3	121	9	7	123	9	7
Cervical stump	14	2	14	18	2	11
	829	94	11	872	71	9

TABLE IV—LENGTH OF FOLLOW UP IN SIXTY "CURED" PRIMARY CASES, 1928

	All treatment	Hysterectomy with or without radium	Radium without hysterectomy
1 year			
5-6	11	5	6
6-7	9	1	8
7-8	5	2	1
8-9	5	3	5
9-10	8	3	5
10-11	12	6	0
11-12	3	2	1
12-13	4	1	0
13-14	2	2	1
Total	60	27	33
Average follow up 1924	60 months or 5 years		
Average follow up 1928	104 months or 8 years 8 months		

1928 reports. The reasons for discarding these records are stated in Table I.

Thirty two cases were rejected as they lacked pathological evidence of the presence of cancer. These cases were, however, all alive and well for the stipulated period after treatment.

Twenty five cases were rejected because less than the stipulated period had elapsed from the time of the last treatment, these cases also were alive and well.

Five cases, however, were accepted in the 1924 report as three year cures in which a period of 3 years had not elapsed after the last treatment with radium. These were all cases in which the original treatment was given more than 3 years before, and the later radium treatment was given, without evidence of recurrence, only as a prophylactic measure. One of these was a case of hysterectomy with postoperative prophylactic radiation one, cautery and radium and three were treated by radium alone.

Eight hundred and twenty nine cases (829) remained as satisfactory for study in 1924 and eight hundred and twenty two (822) in 1928.

Table I is a tabular presentation of the rejected and accepted records.

Table II shows the survivals on the 5 year end result basis.

TABLE V—RESULTS OF TREATMENT,  
GROUP 1A

	1924			1928		
	Cases	Cures	Per cent	Cases	Cures	Per cent
Cases in Group 1A	1	3	28	110	25	21
Hysterectomy without radium	41	14	34	38	7	18
8 operative fatalities			19			
Hysterectomy with radium	8	9	32	28	8	28
Pre-operative radium	13	4	30	13	3	23
3 operative fatalities			23			
Postoperative radium	15	5	33	15	5	33
No fatalities						
Hysterectomy with X ray	2	0	0	2	0	0
Hysterectomy with or without radium	71	23	32	68	15	22
Radium alone	30	5	16	30	4	13
Radium with cautery and X ray	14	6	42	14	6	42
Radium with or without cautery	44	11	25	44	10	23
Other treatments	8	1	12	7	0	0

TABLE VI—RESULTS OF TREATMENT  
GROUP 1B

	1924			1928		
	Cases	Cures	Per cent	Cases	Cure	Per cent
Cases in Group 1B	1	0	22	110	18	15
Hysterectomy without radium	16	4	25	15	3	20
6 operative fatalities			37			
Hysterectomy with radium	15	5	33	15	4	27
Pre-operative radium	6	3	50	6	2	33
1 operative fatality			16			
Postoperative radium	9	2	22	9	2	22
No fatalities						
Hysterectomy with or without radium	31	9	29	30	7	23
Radium alone	56	6	10	56	4	7
Radium with cautery	21	7	33	21	7	33
Radium with or without cautery	77	13	16	77	11	14
Other treatment	12	0	0	12	0	0

Table III records the end results as published originally in the report of 1924 and as they must be modified in the table of 1928. It will be noted that the percentage of all cases alive and well on a five year minimum follow up has dropped from 11 to 0 per cent.

Table IV shows the length of the follow up in the 60 'cured' primary cases of the 1928 report. It will be noted that 'cures' both after hysterectomy and after radium treatment of more than 10 years duration are in evidence, although above 10 years the number of 'cures' after hysterectomy exceed those after radium to a slight extent. The average period of follow up for the 1924 series was 5 years and for the 1928 series the average is 8 years and 8 months.

It is interesting to note that although 'late recurrence' such as occurs in cancer of the breast is rare in cases of cancer of the cervix, one case in

TABLE VII—RESULTS OF TREATMENT,  
GROUPS 1A AND 1B COMBINED

	1924			1928		
	Cases	Cures	Per cent	Cases	Cures	Per cent
Cases in Groups 1A and 1B	42	57	23	237	45	19
Hysterectomy without radium	57	18	31	53	10	19
14 operative fatalities			21			
Hysterectomy with radium	43	14	32	43	12	28
Pre-operative radium	19	7	36	19	5	26
4 operative fatalities			21			
Postoperative radium	24	7	29	24	7	29
No fatalities						
Hysterectomy with X ray	2	0	0	2	0	0
Hysterectomy with or without radium	102	32	31	98	22	22
Radium alone	86	11	12	86	8	9
Radium with cautery or X ray	35	13	37	35	13	37
Radium with or without cautery	121	24	19	121	21	17
Other treatment	19	1	5	18	0	0

this series was free from all evidence of disease  $7\frac{1}{2}$  years after treatment with radium, but died of recurrence  $10\frac{1}{2}$  years after treatment.

Table V represents the results of various forms of treatment in the group of 1A cases (those in which the disease is confined to the cervix itself). It is interesting to note that the percentage of 'cures' obtained after hysterectomy with or without radium has dropped from 32 to 22 per cent whereas the percentage of 'cures' obtained by radium with or without cautery or other palliative operation is now practically the same, 23 per cent. It also appears that hysterectomy aided by radium, either before or after operation, gave better results than hysterectomy alone.

Table VI gives the results of treatment in the 1B group or border line cases, in which some extension of the disease has taken place, but in which the broad ligaments are not involved. In this group the 'cures' by hysterectomy have dropped from 29 to 23 per cent and those by radium from 16 to 14 per cent.

Table VII deals with the 1A and 1B groups combined and shows a falling off of the 'cures' after hysterectomy from 31 to 22 per cent, and after radium from 19 to 17 per cent. In groups 1A and 1B it is apparently the cases which were treated by hysterectomy rather than those treated with radium, which have shown the most marked falling off in the number and percentage of successful cases as the follow up period is extended. This is in contrast to the results in the 1C group as will appear in the next table. In considering Table VII we must remember that in these groups hysterectomy with or without radium gave an operative mortality of 18 per cent.

TABLE VIII—RESULTS OF TREATMENT,  
GROUP 1C

	1924			1928		
	Cases	Cures	Per cent	Cases	Cures	Per cent
Cases in Group 1C	310	24	7	305	15	5
Hysterectomy without radium	13	1	7	13	1	7
2 operative fatalities			15			
Hysterectomy with radium	25	4	16	21	4	16
Pre operative radium	19	3	16	19	3	16
No fatalities						
Postoperative radium	6	1	16	6	1	16
No fatalities						
Hysterectomy with or without radium	38	5	13	38	5	13
Radium alone	180	12	6	187	4	2
Fatalities	1	0	5	1	0	5
Radium and cautery or X ray	52	7	13	52	6	11
Radium with or without cautery	241	19	7	230	10	4
Cautery alone	22	0	0	22	0	0
Other treatment	9	0	0	9	0	0

TABLE IX—RESULTS OF TREATMENT,  
GROUP 1D

	1924			1928		
	Cases	Cures	Per cent	Cases	Cures	Per cent
Cases in Group 1D	135	2	1	135	2	1
Hysterectomy without radium	4	0	0	4	0	0
Hysterectomy with radium	2	0	0	2	0	0
Hysterectomy with or without radium	6	0	0	6	0	0
Radium alone	88	1	1	88	1	1
Radium with cautery	27	1	3	27	1	3
Radium with or without cautery	115	2	1	115	2	1
Other treatment	14	0	0	14	0	0

TABLE X—RESULTS OF TREATMENT IN CASES  
OF RECURRENCE AFTER HYSTERECTOMY

	1924			1928		
	Cases	Cures	Per cent	Cases	Cures	Per cent
Recurrences after hysterectomy	141	11	8	141	11	8
Recurrent after hysterectomy	123	9	7	123	9	7
By radium alone		7	7		7	7
By radium and cautery		2	2		2	2
Cancer of the cervical stump	18	2	11	18	2	11
By radium alone		2	2		2	2

The results in the 1A and 1B group have been arranged in the form of a graph (Chart 1). In this chart the years following operation or treatment are indicated on the horizontal line and the percentage of cases alive and well on the vertical line. The broken line represents 93 cases of the early and border line groups treated by hysterectomy, and indicates the dates at which recurrence or death took place in successive cases leaving 24 per cent alive and well at the end of the

TABLE XI—DURATION OF LIFE IN CASES  
NOT "CURED"

	HYSTERECTOMY ALONE		Cases	Months
	Class 1A	Class 1B		
Class 1A			18	27
Class 1B			4	17
Class 1C			9	13
Class 1D				
	RADIUM ALONE		Cases	Months
	Class 1A	Class 1B		
Class 1A			25	28
Class 1B			47	14
Class 1C			167	14
Class 1D			78	9
	RADIUM CAUTERY, AND X RAY		Cases	Months
	Class 1A	Class 1B		
Class 1A			12	9
Class 1B			40	13
Class 1C			22	9
Class 1D				

follow up period. The solid line represents 114 cases treated with radium (without hysterectomy) and again indicates the rapidity with which the cases died off, up to the 18 per cent which were living at the end of the follow up period.

It is to be noted that the primary operative mortality in the hysterectomy cases (18 per cent) is more than counter balanced before the end of the first year by the rapid dropping off of the radium cases and that thereafter the difference between the two lines is not very great but such as it is in favor of hysterectomy.

Table VIII gives the results of treatment in the 1C group in which the disease was believed to involve the broad ligaments at the time of operation or treatment. The results in the relatively small number of cases treated by hysterectomy remain the same, 13 per cent. Of the large number of cases treated with radium with or without palliative operation there was a falling off from 7 to 4 per cent.

It is in this group of advanced cases in which the falling off of the cases treated with radium is most conspicuous. On reflection however this is not surprising because this group includes the more advanced cases in which a cure by any method is relatively rare on account of the internal extension of the disease. With radium destruction or control of the local disease in the uterus may be obtained even in advanced cases when it is used purely as a palliative measure. This period of temporary relief before the further development of the internal manifestations of the disease may apparently extend beyond 3 years and yet fail to reach 5 years in a small percentage of cases treated. From these figures it would appear that better results were obtained in the combination of radium and cauterization than

TABLE VII—RECTOVAGINAL AND VESICOVAGINAL FISTULÆ

	Cases	Fistula	Per cent
Spontaneous	688	8	1.1
After hysterectomy alone	74	4	5.5
After cautery alone	52	3	5.6
After radium alone	363	21	5.7
After hysterectomy and radium	70	4	5.6
After cautery and radium	91	7	7.0
Other methods	13	0	—
	—	47	—

in the cases treated by radium alone. It is to be regretted that so few cases in this series were treated with X ray that an estimate of the importance of the deep X ray in combination with radium cannot be made.

Table IX shows the results of treatment in the 1D group of cases, these being advanced cases with fixation of the uterus or remote extension of the disease. In this series there were only 2 cases alive and well at the end of the 3 year period, and they remain alive and well at the end of the 5 year period. Both cases were treated with radium. As stated in the 1924 report, these cases were erroneously classed as hopeless, due in all probability to the difficulty in distinguishing by clinical examination alone the fixation of the uterus, which is due to cancer in the broad ligaments from a similar infiltration of a purely inflammatory character.

Table X, the results of treatment in cases with recurrence after hysterectomy, remains unchanged from the report of 1924. All of the cases there recorded are included in the 1928 report as still alive and well, and all of these cases were treated with radium.

In the report of 1924, statistics were published dealing with the life duration in the cases which failed of cure, together with the incidence of vesicovaginal and rectovaginal fistulæ and the occurrence of 'local healing' in the cases treated with radium.

These paragraphs are repeated from the 1924 report, as the figures are not changed in any way by the extension of the end result period.

Table XI shows the duration of life in the cases not cured. It will be seen that no material difference exists as between the different methods of treatment.

In the early favorable group radium alone gave a slightly longer average of life, but in the less favorable cases this is not so apparent.

Four cases in the 1B group treated by hysterectomy averaged 27 months. These numbers however are so small that little reliance should be placed upon this isolated observation.

TABLE XIII—LOCAL RESULTS OF TREATMENT

	Cases	Cures	Local Healing	Total
Hysterectomy alone	74	19	3	22
Hysterectomy and X ray	2	0	1	1
Hysterectomy and radium	70	18	13	31
Radium alone	363	24	37	61
Radium and X ray	20	4	6	10
Radium and palliative operation	95	17	14	31
Cautery alone	52	0	1	1
Other methods	12	1	0	1
	688	83	75	158

Rectovaginal and vesicovaginal fistulæ occur spontaneously in cases of cancer of the cervix. There were 8 such cases in the entire series of primary cases (Table VII).

The danger of fistula formation is apparently increased by any method of treatment, thus hysterectomy alone gave 5.5 per cent, cautery alone 5.6 per cent, radium alone 5.7 per cent, and cautery and radium 7 per cent.

It would appear that the danger of fistula formation should not weigh heavily in the choice of methods of treatment.

The value of radium as a palliative measure in the treatment of incurable cases is generally admitted (Table XIII). That life is materially prolonged by the use of radium is hard to prove.

Local healing of the disease in the cervix or vagina was noted, however, in 75 cases which failed of cure. This of course means relief from the offensive discharge and hæmorrhages which are characteristic of the advanced stages of the disease.

Table XIII indicates the methods of treatment which resulted in local cure. The small group of cases in which radium and X ray were used is perhaps most striking. Of 20 cases, 4 were cured of their disease and 6 obtained local

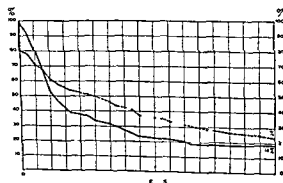


Chart 1. Cancer of the cervix. 207 cases. Broken line 93 cases hysterectomy; solid line 114 cases, radium without hysterectomy.

TABLE XIV—ACTUAL NUMBER OF CASES AND PERCENTAGE OF TOTAL NUMBER "CURED" BY DIFFERENT METHODS OF TREATMENT

822 CASES—71 'CURES'

	Cures	Per cent
Hysterectomy alone	11	15.5
Hysterectomy with radium	16	22.7
Radium alone or with X ray	22	31.0
Radium and palliative operation	22	31.0
Cautery alone	0	0
	71	9

healing. Thus in 50 per cent of this small group the local lesion was destroyed.

Table XIV indicates the actual number of cases and the percentage of the total number which obtained successful results by the different methods of treatment. It will be seen that radium alone or with X ray was responsible for 22 cases, or 26 per cent of the entire number, and radium and X ray, with or without a palliative operation, gave 44 'cures,' or 52 per cent of the entire number treated. This is to be taken merely as an indication of the absolute value of radium in treatment of this series of cases of cancer of the cervix. It is not in any way an indication of the relative value of radium as compared to hysterectomy.

In this second report of the end results of treatment of cases of cancer of the cervix it was proposed to include an analysis of the methods of radiation treatment which were employed. The rapidly changing technique of radium therapy, however, appears to make this an unnecessary labor. Few of the clinics included in this investigation employ now the methods used in the period prior to 1920. It is believed that data of greater value will be obtained from the next series of cases of cancer of the cervix, to be collected by the Committee, which will include the years 1921-22-23.

#### SUMMARY

1. A series of 1,210 cases of cancer of the cervix derived from twenty two different hospitals, recorded in a uniform manner to permit massing of the material supported in every case in which a successful result is claimed by a pathological examination of the tissue and carried to a minimum follow up period of 5 years, and an actual average end result of 8 years and 8 months permits the following conclusions:

2. There were 681 primary cases of which 60, or 9 per cent, are alive and well, and 141 recurrent cases of which 11 or 8 per cent, are alive and well. The successful cases were all treated with

radium or by hysterectomy. No cures were obtained by other methods.

3. In 237 cases of the early favorable and border line groups, hysterectomy alone gave successful results in 1 case in 5. Hysterectomy with radium, either before or after, gave better than 1 in 4, but there was an 18 per cent operative mortality in all the cases of hysterectomy. Radium with or without the cautery gave successful results in about 1 case in 6, but without operative mortality. The best results of all, 1 successful case out of 3 were obtained in the cases in which both radium and cautery were employed. Under these conditions it may be said that the choice between operation and radium in the treatment of early and favorable cases of cancer of the cervix is an open one. It is to be borne in mind that the results of treatment by radium used with the technique of the present day are not yet available but that it is generally believed that they will be better than the figures here presented.

4. In more advanced cases (1C and 1D) the 'cures,' either by radiation or by hysterectomy, were very few.

5. The duration of life in the unsuccessful early cases was somewhat greater after radium than with operation.

6. The formation of rectovaginal and vesicovaginal fistulae occurred with nearly equal frequency with all methods of treatment.

7. Radium with or without X ray or palliative operation was the most important agency in the destruction of local disease in cases which failed to obtain a 'cure.' The value of radium as a palliative measure in advanced cases is beyond dispute.

8. In the treatment of recurrent cases after hysterectomy and in cases of cancer of the cervical stump the use of radium is to be preferred to other methods.

9. A sufficiently large dosage of radium is necessary to obtain destruction of the local lesion. The treatment of cancer of the cervix with inadequate amounts of radium should not be encouraged.

10. It is to be regretted that a study of the pathological material of this series could not be made from the point of view of the pathological classification which was suggested by Broders and later by Martzloff—and elaborated by Schmitz and others.

11. "Late" recurrence even as long as 7½ years following treatment must be recognized as a possibility, though an unusual one in cancer of the cervix.

12 Arguments for the use of radium in preference to hysterectomy in cases of cancer of the cervix are (1) the absence of operative mortality after radiation, and (2) the fact that in cases in which a "cure" is not obtained the best known

palliative method of treatment will have been employed. Diminution of discharge and hemorrhage, even to the extent of local healing, occurs in many of these cases, even though the patient is not cured.

## REPORT No. III — CANCER OF THE BREAST

The third report of this Committee deals with the treatment of cancer of the breast. Abstract cards were prepared and distributed by the Committee<sup>1</sup> and records, classified and recorded in a uniform manner were obtained from the clinics in the various cities which were represented in the investigation. The cases selected for study were those which entered the wards of the hospitals during the calendar years 1918, 1919, and 1920. Each clinic provided an abstract record of every case of cancer of the breast which entered the hospital wards during that period, whether treated by operation, with radium, or by any other method.

From hospitals in Boston, New York, Toronto, Baltimore and Chicago, 774 records were collected, as indicated in Table I. The problem before the committee was to collect accurate data in regard to the end results in cases of cancer of the breast whether treated by operation, by X-ray, or by other methods or combinations of these methods. In order to make possible a fair comparison of the results of all methods of treatment, such data as have been acknowledged by the surgical world to be necessary in reporting the end results of operative treatment of cancer in its various locations, were required in every case (i.e. pathological confirmation of the diagnosis of cancer—and a minimum follow up of 5 years).

It was necessary also to obtain a classification of cases with regard to the extent of the disease present at the time of admission to the hospital in order that the results in early and favorable cases should not be compared directly with those in advanced cases subjected only to palliative treatment. Such a classification of cases based upon the physical examination of the patient at the time of admission and corrected when possible by subsequent operative findings and pathological data has been procured.

The standard surgical report of end results in cancer cases demands microscopic pathological

evidence of the presence of cancer. In operative cases this is readily obtained. In cases suitable only for radiation therapy this is not always deemed to be a safe procedure, but the diagnosis is nevertheless frequently confirmed by the subsequent progress of the disease. This is true also in respect to cases of recurrence after operation, in cases in which the diagnosis depends upon the clinical examination alone. Should such cases occur in the statistics as successful results the facts are noted. Nothing short of a 5 year end result is accepted and cases which did not have sufficient data for classification have been rejected from the investigation.

The word "cure" has been eliminated from this report in deference to criticism of its use in previous reports in connection with cancer of the cervix although the word was used only as a convenient manner of expressing the fact that the patient was alive and well or had died without recurrence at a date later than the designated period of 5 years. The possibility of "late" recurrence, especially in cases of cancer of the breast, is so well recognized that a follow up period of even 20 years would still make it necessary to avoid the unqualified statement that a case was actually cured of the disease.

Radical operation for cancer of the breast at the present day permits of a number of different incisions but is commonly understood to demand the removal in one piece of the following structures. The breast, with all the skin over the breast, the pectoralis major and minor muscles, the axillary contents with the exception of the vein artery, and brachial plexus and the deep fascia from clavicle to epigastrium and from sternum to latissimus. In certain clinics, both in Chicago and New York a modification of this radical operation is practised in which the pectoralis minor is not removed. A comparison of the results of this procedure with those of the standard radical operation is of considerable interest.

From the records available in this investigation, an accurate statement of the details of X-ray treatment is not possible. In the years 1918, 1919, and 1920 treatments with X-ray were given

<sup>1</sup>The members of the Committee (January 19, 1921) are as follows: A. C. Broad, Boston; C. C. Munro, Chicago; C. F. Burnham, Baltimore; G. W. Crile, Cleveland; E. C. Coffey, Chicago; William Dues, Boston; Edwin C. Felt, St. Louis; J. M. T. Fayer, Baltimore; B. J. Lee, New York; Frank Lyche, San Francisco; R. T. Mill, J. F. Halimour, H. K. Fox, coast, Philadelphia; H. C. Wells, Chicago; F. C. Wood, New York City; and R. B. Crenshaw, Boston chairman.



TABLE I—DISTRIBUTION OF SEVEN HUNDRED SEVENTY FOUR RECORDS COLLECTED 1918, 1919, 1920

	Cases
1 Massachusetts General Hospital	177
2 Collis P Huntington Memorial Boston	184
3 Free Hospital for Women Boston	24
4 Mount Sinai Hospital New York	32
5 Toronto General Hospital	29
6 Roosevelt Hospital New York	79
7 Johns Hopkins and St Agnes Hospitals Baltimore	81
8 Peter Bent Brigham Hospital Boston	68
9 Presbyterian Hospital Chicago	100
	774

TABLE II—SUMMARY ALL (774) CARDS 1918, 1919, 1920

Rejected	
Inconclusive data	40
Untraced	52
No treatment	35
Alive and well no pathological report	2
Not cancer	13
Duplication	23
Not of 1918-1919-1920	9
Insufficient data	64
Total rejected	238
Or	
Massachusetts General Hospital	46
Collis P Huntington Memorial Boston	46
Free Hospital for Women Boston	7
Mount Sinai New York	0
Toronto General Hospital	16
Roosevelt Hospital New York	18
Johns Hopkins and St Agnes Hospitals Baltimore	32
Peter Bent Brigham Hospital Boston	19
Presbyterian Hospital Chicago	45
	235
Accepted	536
	774

in most of these hospitals with what would now be considered low voltage apparatus. In other hospitals, however more penetrating radiation was available and was employed. It is to be regretted that accurate data on this subject could not be obtained for a sufficient number of cases to justify conclusions. It may be said, however, that in many hospitals even at the present day low voltage treatments in cases of cancer of the breast are preferred as a routine and high voltage apparatus is used only in cases of definite involvement of the spine, mediastinum pleura, or lung. Radium was used usually by insertion in superficial areas of recurrence, in only a very small number of cases in this series.

It was necessary to reject 238 records of the total of 774 for the reasons recorded in Table II. Forty were inconclusive as to the end result, 52 were entirely untraced, 35 received no treatment, 2 cases were alive and well over 5 years, but had no pathological report to substantiate the diag-

TABLE III—CLASSIFICATION AND PERCENTAGE OF SUCCESSFUL CASES—FIVE YEAR END RESULTS, 1918, 1919, 1920

	Cases	Alive and well	Percent
Primary cases			
1 A glands not involved	80	47	59
1 B/A	3	1	33
1 C/A	20	11	55
	103	59	57
1 B glands doubtful	9	3	33
1 C/B	1	0	0
	10	3	30
1 C glands involved	193	21	11
1 A/C	55	18	33
1 B/C	5	1	20
	253	40	16
Total operable cases	368	102	28
1 D supraclavicular glands	23	0	0
1 E remote metastases	14	0	0
1 F opposite breast involved	1	0	0
	40	0	0
Total primary cases	408	102	25
Recurrent cases			
2 recurrent after radical operation	76	2	3
3 recurrent after incomplete operation			
	52	1	2
Total recurrent	128	3	3
Total cases	536	105	20

TABLE IV—FIVE YEAR END RESULTS IN FOUR HUNDRED EIGHT PRIMARY CASES, 1918, 1919, 1920

	Cases	Alive and well	Percent
Cases	408	102	25
Radical operation without X ray	20	72	33
Radical both pectorals	178	61	34
Radical minor not removed	42	11	26
Radical operation with pre-operative X ray	4	3	75
Radical operation with postoperative X ray	90	20	22
Radical operation with pre and post operative X ray	14	3	21
Radical operation with X ray (pro)	108	26	24
Radical operation with X ray for recurrence	7	0	0
All radical operations with X ray	115	26	23
All radical operations	332	98	29
Incomplete operation alone	20	3	15
Incomplete operation with X ray	21	1	5
Incomplete operation with or without X ray	41	4	10
No operation—X ray only	32	0	0

nosis of cancer. 13 proved not to be cancer, 23 were duplicates, 9 entered the hospital before or after the period under investigation and 64 had insufficient data to permit classification. The rejected cards came from the different hospitals as indicated in Table II. After the elimination of these cases 336 records were available for study.

TABLE V—FIVE YEAR END RESULTS OF TREATMENT IN ONE HUNDRED TWENTY EIGHT CASES RECURRENT AFTER OPERATION, 1918, 1919, 1920

After radical operation	70
After incomplete operation	52
Total	128

	Alive with recurrence	Alive and well
Radical operation without X ray	6	0
Radical operation with X ray	4	0
Excision without X ray	6	0
Excision with X ray	10	4
X ray alone	87	2
No treatment	5	0
	118	7

TABLE VI—LIFE DURATION IN RECURRENT CASES TREATED WITH AND WITHOUT PROPHYLACTIC X RAY, 1918, 1919, 1920

	Cases	Average life duration in months
Radical operation with X ray	85	30
Radical operation alone	130	30
Incomplete operation with X ray	14	0
Incomplete operation without X ray	11	32
X ray no operation	1	33

One hundred twenty eight of these were recurrent cases and 408 were primary cases

Table III gives the classification and percentage of successful cases in the different groups of which we have distinguished six degrees of development of the disease. 1A indicates disease restricted to its point of origin in the breast with the axillary glands not involved either on clinical examination or by pathological examination after operation. 1B/A indicates that the axillary glands on clinical examination were doubtful but were proved not to be involved by pathological examination. 1C/A indicates that clinically the glands were enlarged but on pathological examination they were not malignant. 1B indicates the cases in which the condition of the axillary glands is in doubt but 1C/B would indicate that the glands were felt to be enlarged but that pathological examination was not recorded. These two groups are of course, of little value for study. In the 1C group the axillary glands are enlarged and proved microscopically to be involved with cancer. 1A/C signifies that they were not clinically enlarged but proved to be malignant only on pathological examination.

It is of interest to note the degree of accuracy with which the clinical examination and the

pathological reports agree in regard to the involvement of the axillary glands. In 215 cases the glands were recorded as enlarged, and in 195 of these cases (90 per cent) they proved to be cancerous on pathological examination. In 135 cases axillary glands were recorded as not enlarged, but in 55 of these (40 per cent) pathological examination showed the presence of cancer in the glands after operation. These facts amply justify the usual assumption that the axillary glands should be regarded as potentially malignant in every case of cancer of the breast.

These three groups (1A, 1B, 1C) make up the operable cases, 368, and yield 5 year successful results<sup>1</sup> in 78 per cent. The more advanced cases are included in the next three groups, 1D, supraclavicular glands enlarged, 1E, remote metastases as chest spine, liver, etc., and 1F, disease of the opposite breast. This gives a total of 408 primary cases with a 5 year successful result of 25 per cent. The recurrent cases are divided between 76 cases, recurrent after radical operation, and 52 cases recurrent after incomplete operation. In all of the recurrent cases only 3 per cent gave satisfactory results at the end of the 5 years.

Table IV records the results of different methods of treatment in the 408 primary cases. In this table contrast is made between the cases of radical operation treated with, and those without, prophylactic X ray. Two hundred twenty cases had radical operation without prophylactic X ray with 33 per cent successful. One hundred fifteen had radical operation with prophylactic X ray, either pre operative postoperative or both. These cases gave only 23 per cent of success. Charts 1 and 2 are graphs designed to show the rapidity with which these cases died or developed recurrence after operation. It is to be noted that there is little difference between the curve of the cases which had radical operation alone and that of the cases in which radical operation was supplemented by prophylactic X ray treatment.

Incomplete operations with or without X ray gave only 10 per cent successful results. Cases in which the standard radical operation was done with removal of both pectorals gave 34 per cent success and those in which the minor was not removed gave only 26 per cent. In only 4 cases was pre operative X ray alone given and of this number the end result was successful in 3, or 75 per cent. The numbers, however, are very small.

<sup>1</sup>Of the 105 cases recorded as successful 98 are alive and well and 7 died of disease other than cancer and without recurrence over 5 years after treatment. Of the 431 unsuccessful cases 401 are dead and 30 are recorded as alive with recurrence. There were 21 hospital deaths after operation in the whole series—approximately 3 per cent.

TABLE VII—LOCAL RECURRENCE IN FIELD OF OPERATION IN RECURRENT CASES, AS AFFECTED BY PROPHYLACTIC X RAY, 1918, 1919, 1920

	Cases	Loc 1 recurrence	Per cent
Radical operation without X ray	57	24	44
Radical operation with X ray	59	29	49

cases were given post-operative X ray with 72 per cent success and 14 were given both preoperative and postoperative X ray with 21 per cent success. Thirty two cases were not operated upon but were treated with X ray alone and none of these are living. These figures fail to indicate that the use of prophylactic X ray increases in any way the number of cases of cancer of the breast which are free from recurrence 5 years after operation.

Table V shows the different methods of treatment employed and the results in cases entering the hospital with recurrence after operation. There were 128 of these cases: 76 with recurrence after radical operation and 52 with recurrence after an incomplete operation. Only 3 of these cases are alive and well at the end of the 5 year period, 2 treated by X ray alone and 1 by excision and X ray. In the 2 cases treated by X ray alone the diagnosis of recurrence was a clinical diagnosis only and was not supported by pathological examination of the tissue. In the third case the pathological examination of the excised tissue is not recorded. Of this series 7 other cases are still alive, at the end of the 5 year period, but with clinical evidence of disease. The remaining 128 cases are dead.

Tables VI and VII deal with the results of prophylactic X ray treatment as regards life duration

TABLE VIII—LOCAL RECURRENCE IN SEVENTEEN RECURRENT CASES, 1918, 1919, 1920

	Cases	Average duration of life in months
Without X ray	3	37
With X ray	14	38
Inconclusive omitted	1	
Excised and X ray—alive and well	1	89
Excised and X ray—alive—with recurrence	1	89
Excised no X ray—alive—with recurrence	1	105

and local recurrence in the field of operation in the unsuccessful cases of radical operation. One hundred thirty cases of radical operation alone which failed of cure lived an average of 30 months. 85 cases of radical operation with prophylactic X ray treatment lived also an average of 30 months, 11 cases of incomplete operation without X ray averaged 32 months, while 14 that had X ray lived only 20 months, and 17 cases treated by X ray alone averaged 33 months of life. It is thus seen that prophylactic X ray does not add to the life duration in cases of radical operation which fail of cure.

It has been maintained that prophylactic X ray tends to diminish the frequency of local recurrence within the field of operation. Table VII gives data on this subject, and although precise information as to the location of recurrence was not available in every case there are sufficient data to justify conclusions. In 54 cases of radical operation without X ray 24 or 44 per cent, showed local recurrence in the field of operation while in 59 cases of radical operation which did have prophylactic X ray 29 or 49 per cent, showed local recurrence. In this respect also

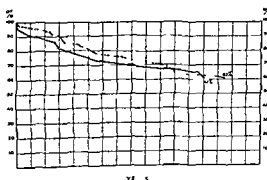


Chart 1. Ninety three cases. Class A. Axillary glands not involved. Broken line indicates 63 radical operations without X ray. Solid line 24 radical operations with prophylactic X ray.

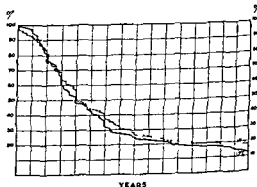


Chart 2. Two hundred nineteen cases. Class C. Axillary glands involved. Broken line indicates 149 radical operations without X ray. Solid line indicates 70 radical operations with prophylactic X ray.

TABLE IX—AXILLARY RECURRENCE IN TWENTY NINE RECURRENT CASES, 1918, 1919, 1920

	Cases	Time interval in months
Class 2C—Local recurrence with axillary involvement (after radical operation)		
X ray alone (recurrence not proved by pathologist) alive and well	1	86
X ray (2 of these excision also) alive with recurrence	3	34 to 94
X ray alone—died	9	4 to 66
Total Class 2C	13	
Class 3C—Local recurrence with axillary involvement (after incomplete operation)		
X ray alone (recurrence not proved by pathologist) alive and well	1	49
Excision—no X ray—died	3	3 to 79
X ray alone—died	4	6 to 37
Operation and X ray—died	3	8 to 69
Inconclusive—omitted	3	
Total Class 3C	16	
Summary 2C and 3C—Local recurrence in axilla	29	
Without X ray	3	24
With X ray	1	35
Inconclusive—omitted	3	
With X ray (no excision neither proved) alive and well	2	86 to 99
With X ray alive with recurrence	3	34 to 89

there appears to be no material advantage to the patient in the employment of prophylactic X ray as a supplement to radical operation

An opportunity is provided by these records to estimate the value of the treatment by X ray of definite recurrence of cancer of the breast after operation. Tables VIII IX and X show the results in these cases. As with the primary cases they are classified according to the extent of the disease at entrance. Table VIII shows the results of treatment in 17 cases of the group in which recurrence is present only in the field of operation without evidence of more remote extension. Three without X ray treatment lived an average of 31 months, 13 that had X ray lived 38 months. One case in which the local recurrence was excised and X ray treatment given is alive and well now 80 months after entrance.

Table IX deals with cases of axillary recurrence—29 cases. Five cases without X ray treatment averaged 24 months duration, 21 cases with X ray treatment averaged 35 months duration. Two of the X ray patients are alive and well at 86 and 99 months. (In neither case was the clinical diagnosis of recurrence proved by pathological examination.)

Table X gives the results in the more advanced groups with supraclavicular recurrence (2D and

TABLE X—RESULTS IN MORE ADVANCED GROUP, 1918, 1919, 1920

	Cases	Time interval in months
Class 2D 3D—Supraclavicular involvement		
Excision alone—died	1	5
Excision and X ray—died	4	3 to 54
No treatment—died	3	0 to 9
X ray alone—died	35	1 to 48
Total Class 2D 3D	43	
Class 2E 3E—Remote metastases		
No treatment—died	3	1 to 3
X ray—died	16	1 to 44
Inconclusive—omitted	1	
Total Class 2E 3E	20	
Class 2F 3F—Opposite breast involved		
Operation alone—died	4	1 to 48
No treatment—died	1	24
Operation and X ray—died	3	1 to 56
X ray alone—died	6	2 to 38
Inconclusive—omitted	1	
Total Class 2F 3F	15	
Class 2G 3G—Recurrence in chest wall		
Excision and X ray—died	2	14 to 27
Total Class 2G 3G	2	

3D) with remote metastases in spine, lung, liver, etc. (2E and 3E) with involvement of the opposite breast (2F and 3F) and in the chest wall (2G and 3G). All of these cases are dead. Those of supraclavicular recurrence averaged 15 months' duration on X ray treatment, remote deep metastases averaged 14 months and involvement of the other breast 13 months. The longest duration of any of the Table X advanced cases was 56 months, a case of double amputation for cancer of the second breast followed by X ray. From these data on the treatment of recurrence we may conclude that X ray prolongs life but that very few cures by X ray alone are to be expected.

#### SUMMARY AND CONCLUSIONS

1 The study of 536 cases of cancer of the breast from 9 different hospitals in 1918, 1919, and 1920 recorded and classified in a uniform manner on a minimum 5 year end result basis and supported by pathological evidence of the diagnosis of cancer, yields the following results:

2 Twenty per cent of all cases entering the hospital are alive and well at the end of 5 years after treatment.

3 Twenty five per cent of all primary cases are alive and well at the end of 5 years.

4 Twenty eight per cent of the "operable" cases are alive and well at the end of 5 years.

5 The early favorable cases without axillary involvement give 57 per cent of successful results

6 The more advanced cases with axillary glands involved gave only 16 per cent of successful results

7 The "inoperable" cases, with remote metastases, are all dead

8 Of the cases entering the hospital with recurrence after operation only 3 per cent are alive and well

9 No successful results were obtained without operative treatment

10 In primary cases the best results (29 per cent) were obtained by the standard radical operation, with or without prophylactic X ray<sup>1</sup>

11 In primary cases incomplete operation with or without X ray gave only 10 per cent success

12 In primary cases X ray alone gave no success

13 The results of the standard radical operation with removal of both pectoral muscles (34 per cent) were superior to those in which the pectoralis minor was not removed (26 per cent)

14 The addition of pre operative or post operative prophylactic X ray treatment to the

<sup>1</sup>Exact data as to dosage of X-ray employed in these cases were not always available. In general low voltage treatment was in use at this time. (See text)

radical operation gave no greater proportion of 5 year successful results

15 Prophylactic X ray did not prolong life in the unsuccessful cases

16 Prophylactic X ray did not diminish the incidence of local recurrence in the field of operation in unsuccessful cases

17 There is no evidence in this series of cases to support the contention that prophylactic X ray is of value as a supplement to operation in cases of cancer of the breast

18 The value of X ray in the treatment of recurrence after operation is established

19 Three patients are alive and well over 5 years as a result of X ray treatment of recurrence. In one of these excision of the recurrence was performed, in addition to X ray treatment but in no case was the recurrence proved by pathological examination

20 Patients with recurrence treated by X ray lived longer than those in which X ray treatment was not given

21 The most marked benefit from X ray treatment was obtained in the cases of local recurrence in the field of operation or in the axillary region

22 Advanced cases with remote metastases were little benefited by X ray treatment

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ALFRED A. STRAUSS

## PRELIMINARY CLINICAL PROGRAM FOR THE CLINICAL CONGRESS

A PRELIMINARY program of the clinics and demonstrations to be given in the hospitals and medical schools of Chicago during the nineteenth annual Clinical Congress of the American College of Surgeons which opens on Monday, October 14th continuing for five days up to and including Friday, October 18th will be found in the following pages. The clinical program as here published is merely an outline of what the clinicians of Chicago expect to present at this year's session. The hospital schedules are to be revised and expanded during the weeks preceding the Congress to present more completely the details of the clinical work to be demonstrated. Chicago surgeons are keenly interested to provide a complete showing of the clinical surgical activities of this great medical center. It will be noted that the program provides for operative clinics and demonstrations beginning at 2 o'clock on Monday and continuing during the mornings and afternoons of each of the following four days.

Since the last session of the Clinical Congress in Chicago in 1923 a number of new hospitals have been built, some of the older institutions have been remodeled and enlarged and in keeping with the growth of the city its clinical facilities have been largely increased.

It is quite evident at this time that Chicago's popularity as a clinical center will be maintained at this year's Congress. There has been an unusually heavy advance registration on the part of those who are planning to be present and in addition a wide spread interest in the plans for this year's meeting is apparent.

The real program of the Congress will be issued daily in the form of bulletins to be posted at headquarters each afternoon, thus providing a complete and accurate schedule of the clinics and demonstrations to be given at each of the hospitals on the following day. Printed bulletins will be distributed each morning.

Special attention is to be devoted to the demonstration of modern methods in the treatment of fractures. At the Cook County Hospital a special fracture clinic will be conducted each morning and afternoon and at many of the larger hospitals plans are being made for a complete showing of the methods and end results in this special field which forms so large a part of the surgical work in this great city.

An added clinical feature of importance at this year's session will be provided by a series of clinics to be given by outstanding surgeons of the American continent on Tuesday and Wednesday afternoons beginning at 2 o'clock in the grand ballroom of the Stevens Hotel. Among those who will give clinics are the following: George W. Crile, Cleveland; John B. Deaver, Philadelphia; John M. T. Finney, Baltimore; Charles H. Mayo, Rochester. A symposium on pernicious anemia will be presented by Charles A. Eliott, Chicago; George H. Whipple, Rochester, New York; C. C. Sturgis, Ann Arbor, Michigan; and William P. Murphy, Boston.

Of especial interest to those whose practice is limited to surgery of the eye, ear, nose and throat are the plans of the sub-committee in charge of that section of the program. As shown in the preliminary program, the ophthalmologists

and otolaryngologists of Chicago are planning a highly interesting clinical program of broad scope. In addition, two evening scientific meetings are planned one on Tuesday evening at which a series of papers dealing with surgery of the eye will be presented and a second session on Wednesday evening when the papers will be devoted to various aspects of otolaryngological surgery.

An important feature of this year's Congress will be the showing of several surgical films that have been produced under the supervision and approved by the Board on Medical Motion Picture Films. Several such films will be given their premier showing in Chicago. Also it is planned to exhibit certain other surgical films.

A conference on traumatic surgery is planned for Friday with sessions both morning and afternoon. The chairman of the Committee on Traumatic Surgery will report on the work of the Committee in recent years and outline future activities in this highly important department of the work of the College. The program for this conference includes an open forum for the discussion of the various phases of the subject and a formal presentation of papers by outstanding men. Leaders in industry, education and labor, together with representatives of indemnity companies, surgeons, and hospital administrators will contribute to the discussion. A detailed program for this conference is in preparation and will be published at an early date.

General headquarters for the Congress will be established at the Stevens Hotel located on Michigan Avenue between Seventh and Eighth Streets where the grand ballroom, three smaller ballrooms and many other large rooms have been reserved for the exclusive use of the Congress for the scientific meetings, hospital conferences, registration and ticket bureaus, bulletin boards, scientific exhibits, executive offices, etc. All of the evening meetings are to be held in the grand ballroom, the same room being used for the hospital conference on Monday, the annual meeting on Thursday afternoon and the conference on traumatic surgery on Friday.

#### EVENING SESSIONS

Programs for a series of five evening meetings are being prepared by the Executive Committee of the Clinical Congress. At the presidential meeting on Monday evening in the grand ballroom of the Stevens Hotel the President elect, Major General Merritt W. Ireland, surgeon general of the army, is to be inaugurated and will deliver the annual address. Dr. D. P. D. Wilkie, professor of surgery in the University of Edin-

burgh will deliver the Murphy oration in surgery on the same evening. Scientific meetings are planned for Tuesday, Wednesday, and Thursday evenings at which eminent surgeons of the United States and Canada and distinguished visitors from abroad will present papers dealing with surgical subjects of present day interest. The annual convocation of the College, at which the 1929 class of candidates for fellowship will be received, is to be held on Friday evening in the grand ballroom of the Stevens Hotel.

#### ANNUAL MEETING—CANCER SYMPOSIUM

The annual meeting of the Fellows of the College will be held at 2 o'clock Thursday afternoon in the grand ballroom at which time the reports of officers and committees will be presented and officers elected for the ensuing year. Immediately following the annual meeting there will be presented a symposium on the treatment of malignant diseases with radium and X-ray, which will include contributions by distinguished surgeons and research workers dealing with many aspects of this problem.

#### ANNUAL HOSPITAL CONFERENCE

The keynote of this year's Hospital Conference will be 'the care of the patient.' In discussing the everyday problems of the boards of trustees, medical staffs, and hospital executives, with a view to promoting better understanding and closer relations among the several groups that have to do with the care of the patient, this will be the predominant idea.

The Hospital Conference opens at 9:30 on Monday morning, October 14th, in the grand ballroom of the Stevens Hotel at which time the President of the College, Dr. Franklin H. Martin, will present the annual report for 1929 and the official list of approved hospitals. Dr. Arnold H. Kegel, commissioner of health for Chicago, will deliver the address of welcome which will take the form of an appeal for full co-operation between the medical profession, hospital executives and health departments. Dr. Malcolm T. MacEachern, associate director of the College in charge of hospital activities, will discuss hospital problems of the present and future.

The feature of Monday afternoon's program will be the practical demonstration of a model staff conference by one of the local hospital groups together with a discussion of the entire subject of staff conferences.

A symposium on the prevention of infection and a round table conference on administrative

problems, admission of patients, the clinical laboratory, the social worker, etc., are important features of the second day's program and will include a practical demonstration of an administrative conference.

On Wednesday morning there will be a joint session with the Association of Record Librarians given over to a symposium dealing with the efficiency of case records.

The complete program for the hospital conference includes sessions both morning and afternoon for the four days, Monday to Thursday inclusive, Friday being left free for visiting Chicago hospitals and sightseeing. The Hospital Conference is planned to interest not only surgeons but also hospital trustees, executives and personnel generally, and an invitation is extended to all persons who are interested in hospital activities to attend this year's Conference. Those who plan to attend are invited to avail themselves of the other activities of the Congress, and especially to attend the presidential meeting on Monday evening and the convocation on Friday evening.

#### REDUCED RAILWAY FARES

The railways of the United States and Canada have authorized reduced fares on account of the Chicago session of the Clinical Congress so that the total fare for the round trip will be one and one half the ordinary first class one way fare. To take advantage of the reduced rates it is necessary to pay the full one way fare to Chicago procuring from the ticket agent when purchasing ticket, a "convention certificate" which certificate is to be deposited at headquarters for the use of a special agent of the railways. Upon presentation of a valid certificate to the ticket agent in Chicago not later than October 30th a ticket for the return journey by the same route as traveled to Chicago may be purchased at one half the one way fare.

In the eastern, central, and southern states and eastern provinces of Canada, tickets may be purchased between October 10th and 18th in south western and western states between October 6th and 17th, and in the far western states and western provinces of Canada between October 6th and 14th. The return journey from Chicago must be begun not later than October 30th.

The reduction in fares does not apply to Pullman fares nor to excess fares charged for passage on certain trains. Local railroad ticket agents will supply detailed information with regard to dates of sale, rates, routes, etc. Stop-overs on both the going and return journeys may be had within certain limits.

Full fare must be paid from starting point to Chicago, and it is essential that a "convention certificate" be obtained from the agent from whom the ticket is purchased. These certificates are to be signed by the general manager of the Clinical Congress and used by a special railroad agent in Chicago during the meeting. No reduction in railroad fares can be secured except in compliance with the regulations outlined and within the dates specified. It is important to note that the return trip must be made by the same route as that used to Chicago and that the certificate must be presented during the meeting and return ticket purchased and used not later than October 30th.

It will be noted that the arrangement outlined above, extending the return limit to October 30th, allows for an additional twelve days following the close of the Clinical Congress that may be devoted to visiting other clinical centers in the middle west.

An exception to the above arrangement is to be noted in the case of persons traveling from points in the Pacific and certain western states and British Columbia, who will be able to purchase round trip summer excursion tickets which will be on sale up to and including September 30th with a final return limit of October 31st. The summer excursion fare is somewhat lower than the convention fare mentioned above, but is available only in certain of the far western states and British Columbia. Tickets sold at summer excursion rates permit traveling to Chicago via one direct route and returning via another direct route with liberal stop over privileges.

#### LIMITED ATTENDANCE

Attendance at the Chicago session will be limited to a number that can be comfortably accommodated at the clinics, the limit of attendance being based upon the result of a survey of the amphitheatres, operating rooms, and laboratories in the hospitals and medical schools to determine their capacity for accommodating visitors. Under this plan it will be necessary for those who wish to attend to register in advance.

Attendance at all clinics and demonstrations will be controlled by means of special clinic tickets, which plan provides an efficient means for the distribution of the visiting surgeons among the several clinics, and insures against over crowding, as the number of tickets issued for any clinic will be limited to the capacity of the room in which that clinic will be given. Clinic tickets will be distributed each morning and may be reserved late on the previous day.



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## REGISTRATION FEE

A registration fee of \$5 00 is required of each surgeon attending the annual Clinical Congress, such fees providing the funds with which to meet the expenses of the meeting. To each surgeon registering in advance a formal receipt for the registration fee is issued which receipt is to be exchanged for a general admission card at headquarters. This card, which is non transferable, must be presented to secure clinic tickets and admission to the evening meetings.

## CHICAGO HOTELS AND THEIR RATES

In recent years a number of fine large hotels have been built in Chicago, among which is the Stevens with its 3000 guest rooms. Ample first class hotel facilities are available, many of the hotels being located within short walking distance of the headquarters hotel.

	Min over	
	Rates w th Bath	
	9 124	De tie
	Room	Room
Auditorium Michigan Ave and Congress St	\$3 50	\$5 00
Belmont 3100 Sheridan Road	4 00	5 00
Bismarck 175 W Randolph St	3 50	5 00
Blackstone Michigan Ave and East 7th St	5 00	10 00
Chicago Beach Hyde Park Blvd at the Lake	5 00	5 00
Congress Michigan Ave and Congress St	4 00	6 00
Drake Michigan Ave and Walton Place	5 00	6 00
Edgewater Beach 5349 Sheridan Road	4 00	6 00
Fort Dearborn Van Buren and LaSalle Sts	1 95	3 00
Great Northern Jackson Blvd and Dearborn	3 50	4 50
Knickerbocker Walton Place and Michigan	3 00	5 00
Lake Shore Drive 181 Lake Shore Drive	5 00	7 00
LaSalle LaSalle and Madison Sts	3 00	4 50
Morrison Clark and Madison Sts	2 50	5 00
Palmer Monroe and State Sts	4 00	7 00
Parkway 211 Lincoln Park West	3 00	2 00
Pearson St Clair and Pearson Sts	3 50	5 00
Sherman Clark and Randolph Sts	3 00	4 00
Stevens Michigan Ave and 7th St	3 50	6 00
Webster Lincoln Park West at Webster Ave	3 00	5 00

## PRELIMINARY CLINICAL PROGRAM

## GENERAL SURGERY, GYNECOLOGY, OBSTETRICS, UROLOGY, ORTHOPEDICS

## COOK COUNTY HOSPITAL

## Monday

- F H FALLS—2 Operative obstetrics  
 SUMNER L KOCH—2 Surgery of the hand general surgery

## Tuesday

- R W McNEALY—9 Blood vessel surgery  
 A E KANTER—9 Operative gynecology  
 W R CLUBBINS—9 Ward walk in fracture ward  
 E L CORNELL—9 Complications of pregnancy and labor  
 H JACKSON—10 Injuries of the brain  
 J R HARGER—10 Acute osteomyelitis  
 E M MILLER—10 Toxic thyroid disease in children purpura hemorrhagica  
 D C STRAUSS—11 Surgery of the thyroid  
 KELLOGG SPEED—2 Tumors of bone fractures of carpal bones

GEORGE DE TARNOWSKY—2 Rupture of the bladder

E J LEWIS—2 Sliding hernia

J P GRIFFIN—2 Operative gynecology

## Wednesday

- HARRY CULVER—9 Genito-urinary surgery  
 W R CLUBBINS—9 Round table discussion on fractures  
 H SCHMITZ—9 Inflammation of the pelvic organs carcinoma of the pelvic organs  
 F J JIRKA—10 General surgery  
 P H KRELSCHER—10 Osteomyelitis congenital deformities arthroplasty of hip arthroplasty of elbow  
 J R BUCHBINDER—2 Surgery of the thyroid  
 F H FALLS—2 Operative obstetrics  
 J P FITZGERALD—2 Obstetrical complications  
 H C ROYLNICK—2 Intravenous anesthesia in urologic surgery  
 SUMNER L KOCH—2 Surgery of the hand general surgery

## Thursday

- R W McNEALY—9 Blood vessel surgery  
 J R HARGER—10 Acute osteomyelitis  
 E M MILLER—10 Fractures about the elbow in children  
 H JACKSON—10 Operations under spinal anesthesia  
 KARL MEYER—10 Gastric surgery  
 W R CLUBBINS—2 Fractures of femur  
 D S HILLIS—2 Obstetrics  
 A F LASH—2 Treatment of puerperal infection

## Friday

- G L APPELBACH—9 Surgical complications of diabetes  
 A E KANTER—9 Operative gynecology  
 E L CORNELL—9 Complications of pregnancy and labor  
 F A DYLS—10 Thyroid disease carcinoma of the breast  
 A C DAVID—10 Carcinoma of large bowel  
 GEORGE DE TARNOWSKY—2 General surgery

## GARFIELD PARK HOSPITAL

## Wednesday

- C C ROGERS H L BAKER J M BERGER F L BROWN  
 G G FOSHER J R HARGER L F MACDIARMID and  
 F D MOORE—9 General surgery  
 VINCENT J O CONOR—9 Genito-urinary clinic Medical  
 aspects presented by Dr THEODORE TEIKEN pathology  
 by Dr P SCHMITZ roentgenology by Dr JARLE

PASSAVANT MEMORIAL HOSPITAL—NORTH  
WESTERN UNIVERSITY MEDICAL SCHOOL

## Monday

- CHARLES A ELLIOTT and associates—2 Symposium on diseases of the liver and bile passages Cirrhosis of the liver by Paul Starr, surgery in jaundiced patients by H M Richter the gall bladder hormone by A C Ivy the spinal cord pathway of afferent impulses from the gall bladder by J T Hart and R C Crain

## Tuesday

- H M RICHTER—9 Cholecystectomy cholelithiasis  
 LOYAL DAVIS—9 Trigeminal neuralgia  
 S W RANSON L J TOLLOCK and LOYAL DAVIS—2 Symposium on the diagnosis and surgical treatment of diseases affecting muscle function

## Wednesday

- ALLEN B KANAVEL—9 Thyroid surgery  
 J R BUCHBINDER—9 Thyroid surgery  
 JAMES G CARR CHARLES A ELLIOTT H M RICHTER, and  
 ALLEN B KANAVEL—2 Symposium on diseases of the thyroid gland

## Thursday

- H M RICHTER—9 Thyroid surgery  
 LOYAL DAVIS—9 Brain tumor  
 ALLEN B KANAVEL SUMNER L KOCH, MICHAEL L MASON  
 and C G SHEARON—2 Symposium on surgery of the hand

## Friday

- ALLEN B KANAVEL—9 Dupuytren's contraction  
 SUMNER L KOCH and MICHAEL L MASON—9 Tendon transplantation  
 (Note—Morning clinics at Passavant Memorial Hospital after-noon clinics at Northwestern University Medical School)

## ST LUKE'S HOSPITAL

- I L McARTHUR S W McARTHUR H E JONES C A  
 HEDBLOM SAMUEL PLUMMER and W B TISK—9  
 daily General surgical clinics  
 LOUIS SCHMIDT and HARRY CULVER—9 daily Genito-  
 urinary clinics  
 L L RYERSON PHILIP LEWIS R O RITTER F A  
 CHANDLER and H B THOMAS—9 daily Orthopedic  
 clinics  
 ARTHUR H CURTIS and H O JONES—2 daily Gynecological  
 clinics

## COLUMBUS HOSPITAL

## Monday

- D A ORTH—2 Abdominal surgery

## Tuesday

- FRED MULFILLER—2 Orthopedic surgery

## Wednesday

- M J SEIFERT and D RUFF—9 Gastric surgery

## Thursday

- Drs WILLIAM and LENA SADLER—9 Gynecological  
 surgery

## MERCY HOSPITAL

## Monday

- R S BERGHOF—2 Differential diagnosis of chest diseases  
 JOSEPH LAIBER—2 Urologic surgery the relation of urology to gynecology  
 P H KREUSCHER—2 Congenital dislocations of the hip injection treatment of varicose veins

## Tuesday

- L D MOOREHEAD—9 Surgery of the thyroid gland Exophthalmic goiter toxic adenoma parenchymatous goiter and mixed type of goiter  
 J I GOLDEN—9 Abdominal surgery  
 F C JACOBSEN—9 Fractures in industrial surgery  
 J B O'DONOGHUE—2 Tumors of breast their surgical significance clinical significance of reverse peristalsis of the upper intestinal tract particularly in reference to gastrojejunal anastomosis reaction of different classes of thyroid cases to surgery and treatment of some unusual complications  
 C L MARTIN—2 Polyps of the rectum and sigmoid tuberculous ulcers of the sigmoid and rectum.

## Wednesday

- C F SAWYER—9 Pancreatitis—acute subacute and chronic types of intestinal obstruction  
 M F McLAUGHLIN—9 Treatment of diseases of the gall bladder and bile ducts carcinoma of the colon  
 J E KELLEY—9 The acute abdomen  
 HENRY SCHMITZ—2 Early diagnosis and treatment of uterine and mammary cancers Diagnosis and treatment of sterility due to blocked uterine tubes  
 M C MULLEN—2 Toxemias of pregnancy

## Thursday

- P H KREUSCHER—9 Treatment of advanced scoliosis Fractures involving the knee joint fractures of the hip  
 F E PICKER—9 Fracture clinic  
 F M DRENNAN L E GARRISON and C F SAWYER—2 Joint discussion on duodenal pathology with presentation of cases and the results of some experimental work consideration of esophageal stenosis by Dr Drennan  
 M MANDEL—2 Pernicious anemia

## Friday

- HENRY SCHMITZ—9 Gynecological surgery  
 GEORGE GRIFFIN—9 Gastro-intestinal surgery  
 J D CLARIDGE—9 Dislocation of internal semilunar cartilage  
 W S BARNES—2 Gynecological clinic  
 W J PICKETT—2 Fascial suture in the repair of hernia  
 A V PARTIPILO—2 Closed aseptic gastro-intestinal anastomosis  
 B B HETSON—2 Dermatological conditions which may become surgical

## MUNICIPAL TUBERCULOSIS SANITARIUM

## Thursday

- CARL A HEDBLOM—9 30 Surgery of the chest in tuberculosis operative clinic and demonstration of end results

## Friday

- CHARLES M McKENNA—9 30 Tuberculosis of the kidney operative clinic and demonstration of pathologic types of renal tuberculosis  
 BENJAMIN GOLDBERG and associates—2 Special measures in the general care of surgical tuberculosis

## MICHAEL REESE HOSPITAL

## Tuesday

- ALFRED A STRAUSS Stomach resection for gastric and duodenal ulcer, common duct duodenal anastomosis for recurrent gall stones  
 HARRY JACKSON Bone tumors and osteomyelitis  
 D C STRAUSS Thyroid surgery  
 IRVING S KOLL Pyelotomy for stone nephrectomy for kidney tumor urethral plastics  
 JULIUS E LACKNER Abdominal hysterectomy interposition operation rectovaginal fistula  
 W H RUBOVITS Obstetrical demonstration of forceps version and complete suture episiotomy

## Wednesday

- ALFRED A STRAUSS Gastric resection for ulcer and a complete colectomy and blood transfusion  
 GEORGE L DAYENPORT General surgery, surgery of the central nervous system  
 RALPH B BETTMAN Surgery of the chest  
 J S EISENSTADT Undescended testes and prostatectomy  
 CHARLES W JACOBS and DANIEL LEVENTHAL Orthopedic surgery

- L F FRANKENTHAL Gynecological operations

## Thursday

- ALFRED A STRAUSS Stomach resection for gastric and duodenal ulcer and carcinoma of the colon  
 GEORGE L DAYENPORT General surgery  
 D C STRAUSS Gall bladder surgery  
 JOSEPH L BAER Complete perineal laceration ovarian tumor and pelvic inflammation  
 IRVING STEIN Obstetrical demonstration low cervical caesarean under local anesthesia  
 GUSTAV KOLISCHER Bladder tumors  
 HARRY C ROLNICK Prostatectomy

## Friday

- ALFRED A STRAUSS Gastric resection for carcinoma and gall bladder surgery  
 GEORGE BETTMAN General surgery of malignant tumors  
 HELMOLD SCHILLER General surgery treatment of extensive carbuncle  
 HARRY KATZ Diverticulum of bladder  
 ALFRED L JONES Spinal anesthesia and prostatectomy  
 JULIUS E LACKNER and W H RUBOVITS Urinary fistula Wertheim operation for carcinoma of the cervix plastic repair  
 JOSEPH L BAER and IRVING STEIN Prolapse vaginal hysterectomy fibroids occiput posterior

## MOUNT SINAI HOSPITAL

## Tuesday

- V L SCHRAGER—9 Abdominal surgery with special reference to interpretation and management of surgical risks

## Wednesday

- I E BISKOW—9 Abdominal surgery  
 A E KANTER—9 Vaginal plastics hysterectomies

## Thursday

- V L SCHRAGER—9 Abdominal surgery with special reference to interpretation and management of surgical risks  
 L HANDELMAN—9 General surgical operations

## Friday

- J MORRIS and B A WILLIS—9 Goiters fractures  
 M RUBINSTEIN—9 Orthopedic surgery Synovectomies of knee joint fusion

## WESLEY MEMORIAL HOSPITAL

Monday

M T GOLDSTINE—2 Hysterectomy vaginal plastics

Tuesday

G DE TAKATS—9 Varicose veins spinal anesthesia, thyroidectomy local anesthesia

GUY S VAN ALSTYNE—9 General surgery

LOYAL DAVIS—2 Brain surgery

Wednesday

R W McNEALY—9 Hernias and blood vessel surgery

ALLEN B KANAVAL—9 General surgery

JOHN A WOLFER—9 Duodenal stasis and pseudoenteritis

P B MAGNUSON and WILLIAM A HENDRICKS—2 Plastic on hip spinal fusion

Thursday

EUGENE B PERRY—9 Cystoplasties and kidney surgery

O S PAVLIA—10 Hysterectomy and ovarian transplantation

ALLEN B KANAVAL—9 General surgery

V D LESPINASSE—2 Genito urinary surgery

C J DEBERE—4 Rectal surgery

Friday

R W McNEALY—9 General surgery

MICHAEL MASON—10 Dupuytren's contracture

J J GILL—10 Obstetrical surgery pathological obstetrics

M C ERICK—2 Hysterectomy ovarian cysts

P B MAGNUSON and WILLIAM A HENDRICKS—2 Plastic on hip spinal fusion

## AUGUSTANA HOSPITAL

Tuesday

NELSON M PERCY—9 Thyroid clinic general abdominal surgery spinal anesthesia

R J ODEN—9 General surgery

Wednesday

O E NADEAU—9 General urological surgery

J W NIZUM—9 General surgery

E H OCHSNER—9 General surgery

D W CRILE—10 Orthopedic surgery

Thursday

NELSON M PERCY—9 Thyroid clinic general abdominal surgery spinal anesthesia

R J ODEN—9 General surgery

Friday

O E NADEAU—9 General urological surgery

J W NIZUM—9 General surgery

E H OCHSNER—9 General surgery

D W CRILE—10 Orthopedic surgery

## ST ANTHONY DE PADUA HOSPITAL

Tuesday

LAWRENCE RYAN FRED EHLMANN STEPHEN DOVLOV and JOSEPH ZABORSKY—9 General surgical operations

OTTO J HIRSA—9 Genito urinary surgery

L S TICHY—9 X ray demonstration

Thursday

JOHN SPRACKA FRED OLLENTINE FRANK JIRKA and RALPH CYPLER—9 General surgical operations

HARRY SMIJEL—9 Genito urinary surgery

MAX WEISBERG—9 Obstetrics

L S TICHY—9 X ray demonstration

## PRESBYTERIAN HOSPITAL

Tuesday

ARTHUR DEAN BEVAN and associates—9 General surgical operations

A D BEVAN DR GATEWOOD and R C BROWN—9 Gall bladder surgery

N SPROAT HEANEY CAREY CULBERTSON A E KANTER E D ALLEN and C P BAUER—9 Gynecology and obstetrics

W C THOMAS—10 30 Blood chemistry and postoperative care

A D BEVAN DR DAVIS, and V C DAVID—11 Surgery of large bowel

A H MONTGOMERY—12 Intussusception

Wednesday

ARTHUR DEAN BEVAN and associates—9 General surgical operations

H L KRETSCHMER R H HERBST, and associates—9 Genito urinary surgery

N SPROAT HEANEY CAREY CULBERTSON A E KANTER E D ALLEN and C P BAUER—9 Gynecology and obstetrics

WILBUR POST—10 30 Medical preparation of poor surgical risks for surgery

A D BEVAN CARL DAVIS E M MILLER, and DR LORING—11 Surgery of the thyroid

ISABELLE HERBST—12 40 Anesthesia in goiter

Thursday

ARTHUR DEAN BEVAN and associates—9 General surgical operations

KELLOGG SPEED—9 Bone surgery

E M MILLER—9 Posterior dislocation of the shoulder

A H FARMLEE—9 Diagnosis of acute osteomyelitis

V C DAVID—9 Regeneration of bone in osteomyelitis

R C WOODLATT—9 Preparation of diabetics for surgery

GEORGE F DICK—9 Frispielas

PETER BASSOE and W J LOTT—9 Charcot joints

A H MONTGOMERY—9 Treatment of burns

N SPROAT HEANEY CAREY CULBERTSON A E KANTER E D ALLEN and C P BAUER—9 Gynecology and obstetrics

H A OBERHELMAN—11 Surgical pathology

Friday

ARTHUR DEAN BEVAN and associates—9 General surgical operations

A D BEVAN DR GATEWOOD R C BROWN D P ABBOTT, and C C CRULEE—9 Surgery of the stomach

N SPROAT HEANEY CAREY CULBERTSON A E KANTER E D ALLEN and C P BAUER—9 Gynecology and obstetrics

E E IKON—10 30 Relation of focal infection to surgery

DR GATEWOOD—11 Subphrenic abscess

F B MOOREHEAD—11 20 Surgery of the mouth and face

## RUSH MEDICAL COLLEGE

Tuesday

CARL DAVIS—11 Surgical clinic

Wednesday

N S HEANEY—11 Gynecological clinic

Thursday

A D BEVAN—11 Surgical clinic

Friday

CARL DAVIS—11 Surgical clinic

## RESEARCH AND EDUCATIONAL HOSPITAL

*Monday*

H B THOMAS—2 Orthopedic surgery

*Tuesday*

CARL A HEDBLOM—10 Thoracic surgery

*Wednesday*

JEROME R HEAD—10 Neurological surgery

I H FALLS—2 Gynecology and obstetrics

*Thursday*

J D KOLCKY—10 General surgery

*Friday*

LINDON SEED—9 Thyroid surgery

LOUIS SCHULTZ—10 Oral surgery

F H FALLS—2 Gynecology and obstetrics

## EVANGELICAL DEACONESS HOSPITAL

*Tuesday*

EDWARD M HIFCOCK—9 Operative treatment of uterine fibroids

*Wednesday*

A J SCHOENBERG—9 Carcinoma of the cervix uteri

I O BOWE—2 Placenta praevia and management of its complications

*Thursday*

C V BACHELLE—9 Operations for ulcer of the stomach and duodenum

L H FRIEDRICH—2 Management of the complications of gonorrhea

*Friday*

PAUL F MORF—9 Gall bladder disease and its operative treatment

ELMER W MOSLEY—2 Caesarean section in contracted pelvis

## LUTHERAN DEACONESS HOSPITAL

*Tuesday*

JOHN D KOLCKY—9 General surgical clinic operations and demonstrations of cases

LINDON SEED—9 Thyroid clinic operations and demonstration of cases

GEORGE H SCHROEDER—9 General surgical clinic operations and demonstration of cases

*Thursday*

JOHN D KOLCKY—9 General surgical clinic operations and demonstrations of cases

LINDON SEED—9 Thyroid clinic operations and demonstration of cases

GEORGE H SCHROEDER—9 General surgical clinic operations and demonstration of cases

## WASHINGTON BOULEVARD HOSPITAL

*Tuesday*

ARTHUR R MEYER—9 Fracture clinic

*Wednesday*

VINCENT J O CONOR—9 Urological clinic

*Thursday*

PAUL C FOX—9 Gynecological clinic

## JOHN B MURPHY HOSPITAL

*Monday*

HENRY R KENNY Surgery of bones and joints arthrodiesis of the knee

WILLIAM GEHL Renal function test urological surgery

I H KAMPP Hallux valgus

*Tuesday*

M J PURCELL Fracture clinic

GUSTAV BRANDLE Operative treatment of cranial injuries

A C SLINDE Conservative surgery for hydronephrosis

S S McNEIL Plastic operations on hand and face

*Wednesday*

ARNOLD H KEGEL Thyroid clinic operation and demonstration of cases

E V J YOUNG Operative treatment of old fracture of the os calcis

JAMES LARAIN Radium treatment of carcinoma of cervix

*Thursday*

WILLIAM GEHL Two-stage suprapubic prostatectomy

JOSEPH LUNNINGHAM Management of the eclamptic patient

JOHN WALLNER Diagnosis and management of sterility

J WILSON GRIMES Surgical treatment of pulmonary tuberculosis

L C McDERMOTT Caesarean section

*Friday*

A C GARVEY Surgical treatment of ulcers of the stomach

J M HAMILTON Surgery of the nervous system

I O BOWE Tendon grafting

JAMES J MCGILVER Carcinoma of the colon and sigmoid

J E LEO Surgery of the gall bladder and common duct

## ILLINOIS CENTRAL HOSPITAL

*Tuesday*

C H PHIPER—9 Dry clinic Abdominal surgery

FARIS CHESLEY—10 Medical aspects of acute abdomen

*Wednesday*

W T HARSHA—9 Thyroid clinic

L SLOAN—10 Medical aspects of toxic goiter

A H BALCHER—11 Pathology of toxic goiter

*Thursday*

HUGH MACHECKNIE—9 Dry clinic general surgery

J C DELPRAT—10 Dry clinic general surgery

BEVERIDE E MOORE—11 Orthopedic surgery

WILLIAM CULFFPER—11 Ray demonstration of pathology of Taget's disease

*Friday*

W T HARSHA and C C CUY—9 Dry clinic General surgery

WILLIAM HEWITT—10 Dry clinic Gynecology and obstetrics

## ALEXIAN BROTHERS HOSPITAL

F W WHITE EDWARD HESS A WOCHINSKI C O ROTCH ALF HOLM and J GLASSER—9 daily Genito-urinary clinic

M L HARRIS ALGUST ZIMMERMAN and DANIEL MERRITT—9 daily General surgical clinic

RALPH WHEELER WILLIAM SWIFT FRANK BAYLOR and A I STEVENS—9 daily Fracture clinic

## WEST SIDE HOSPITAL

## Tuesday

- C. K. G. FORRESTER and H. C. LYMAN—9 Fracture clinic, local anesthesia in reduction of fractures  
 I. W. BROWN—11 Surgery of gastric and duodenal ulcers  
 I. C. GEORGEAN—2 Abdominal surgery management of intestinal obstruction

## Wednesday

- J. S. NAGEL—9 Prostatectomies demonstration of functional tests in renal surgery neoplasms of the kidney  
 C. F. THOMPSON—9 Surgery of the bile tracts  
 S. G. WEST—11 Vaginal hysterectomy vaginal route in pelvic surgery

## Thursday

- C. R. FORRESTER and H. C. LYMAN—9 Results of air insufflation in treatment of sequela of cranial injuries operative treatment of recent and old bone and joint injuries  
 C. C. O'BYRNE—11 Goiter clinic  
 A. M. HARVEY and J. H. CHIVERS—2 Industrial surgery

## Friday

- A. N. CLARKE—9 Radium in the treatment of malignant disease demonstration of cases  
 C. C. SCHUESTER—11 Genito urinary surgery Cystoscopies renal catheterization and X ray demonstration treatment of hydronephrosis

## SOUTH SHORE HOSPITAL

## Monday

- FREDERICK RAHE—2 General surgical clinic  
 ETHELBERG LUTON—3 General surgical clinic

## Tuesday

- HUGH MACKENCHIE—9 General surgical clinic  
 LOUIS D. SMITH—11 Genito urinary surgery  
 MARTIN MERBITZ—2 General surgical clinic

## Wednesday

- CUY VAN ALSTYNE—9 General surgical clinic  
 F. G. O'BRIEN—11 General surgical clinic  
 EDWARD FROB—2 General surgical clinic

## Thursday

- WELLER VAN HOOK—9 General surgical clinic  
 AXEL WERELIUS—10 30 General surgical clinic  
 EDWARD MASTERTON—2 General surgical clinic

## Friday

- FRANK MEAD—9 General surgical clinic  
 F. L. ROSEBOROUGH—10 General surgical clinic  
 FRANK MURPHY—11 Fracture clinic  
 I. F. BLACKWOOD—2 General surgical clinic

## CRANT HOSPITAL

## Tuesday

- A. C. FRYE—9 General surgical clinic  
 D. A. ZIMMERMAN—11 General surgical clinic

## Thursday

- D. A. ZIMMERMAN—11 General surgical clinic

## Friday

- S. COOMBS—9 General surgical clinic

## UNIVERSITY HOSPITAL

## Tuesday

- ADOLPH KRAFT—9 Suppuration about the diaphragm  
 GEORGE M. LANDAL—10 Pathological aspects of the lung from a roentgenological standpoint  
 MAX MYEROWITZ—11 Surgical conditions of Meckel's diverticulum

## Wednesday

- HARRY SINGER—9 Demonstration of gastro intestinal specimens  
 KARL A. MEYER—10 Gastro-intestinal surgery

## Thursday

- ARTHUR H. CONLEY—9 Calcium and phosphorous metabolism in fractures  
 CHARLES DAVISON—10 Surgery of autogenous bone transplants

## Friday

- O. H. ROHRBACK—9 Surgical obstetrics  
 MARSHALL DAVISON—10 Surgery of undescended testes

## CHICAGO MEMORIAL HOSPITAL

## Monday

- VANCE RAWSON—2 Cardiovascular disease and surgery  
 CHARLES J. DRUECK—3 Diverticulitis

## Tuesday

- ARTHUR E. MAHLF—9 Management of the thyroid patient  
 PETER S. CLARK—9 Surgery of the thyroid  
 JULIA C. STRAWN—2 Surgical gynecology  
 JAMES E. FITZGERALD and M. RUTH MCGUIRE—3 30 Surgical obstetrics

## Wednesday

- BENNETT R. PARKER—9 Surgery of the gall bladder and bile tract  
 J. W. PARKER—9 Hydronephrosis and hypernephroma  
 ROBERT A. MELENDY—2 Empyema and allied conditions  
 GEORGE L. BROOKS and ROBERT A. MELENDY—4 Surgery in diabetics

## Thursday

- CHARLES E. KAHILKE—9 Surgery of the stomach and duodenum  
 PAUL M. CLIVER—2 Fractures general management operation treatment and results  
 CHARLES J. DRUECK—3 Unusual rectal fistulas  
 M. L. WEINSTEIN—4 Gall bladder surgery under local anesthesia

## Friday

- LAWRENCE L. ISEMAN—9 The cancer problem

## LUTHERAN MEMORIAL HOSPITAL

## Tuesday

- CHARLES F. STOTZ—9 General surgical clinic

## Wednesday

- ARTHUR G. FREY—9 General surgical clinic

## Thursday

- CHARLES F. STOTZ—9 General surgical clinic

## Friday

- ARTHUR G. FREY—9 General surgical clinic



## RAVENSWOOD HOSPITAL

## Monday

- G W GREEN—2 Gallstone clinic  
G N BUSSEY—2 Abdominal hysterectomy fibroids  
G DE TARNOWSKY—2 Hemorrhagic colitis

## Tuesday

- C A BUSWELL—0 Carcinoma of the cervix uteri  
D B POND—0 Fracture clinic  
R E DYER—0 Fallopian tube visualization with lipiodol  
W F GROSVENOR, C C RENTFRO and F W ROHR—2 Obstetrical conference

## Wednesday

- E B WILLIAMS—0 Abdominal hysterectomy, fibroids  
I J SARMA—0 Abdominal wall incisions based on physiologic grounds  
F VON NAKOWSKI—0 Hepatic abscess

## Thursday

- L WILDER—0 Gout cases  
E W MUELLER—0 Treatment of burns  
W F GROSVENOR, C C RENTFRO and F W ROHR—2 Obstetrical conference  
G DE TARNOWSKY—0 Ruptures of urinary bladder

## Friday

- G W GREEN—0 Surgical clinic  
A G SCHROEDER—0 Surgical clinic

## ST BERNARD'S HOSPITAL

## Monday

- WILLIAM EPSTEIN—2 Gout clinic  
G M CUSHING—2 Gall bladder clinic

## Tuesday

- WILLIAM HECTOR—0 Surgical clinic  
L B DONKLE—0 Surgical clinic  
CHESTER GUY—2 Laboratory demonstrations  
J A PARKIE—2 Surgical clinic

## Wednesday

- J B HAEERLIN—0 Surgical clinic  
EMIL RACH—2 Obstetrical clinic  
B C CUSHWAY—2 Radium cases

## Thursday

- J T MEYER—0 Surgical clinic  
W H BOHART—0 Industrial surgery  
J G FROST—2 Fracture clinic

## CHILDREN'S MEMORIAL HOSPITAL

## Monday

- JOHN A GRAHAM—1 The acute abdomen

## Tuesday

- JAY IRELAND—11 The treatment of empyema in children

## Wednesday

- FREDERICK B MOOREHEAD—0 Cleft lip and cleft palate cartilage transplants for the correction of facial deformities

## Thursday

- ALBERT H MONTGOMERY—0 Pyloric stenosis and intussusception general surgery of children

## ALBERT MERRITT BILLINGS HOSPITAL

## Monday

- LESTER DRAGSTEDT—2 Abdominal surgery, intestinal obstruction

## Tuesday

- PERCIVAL BAILEY—0 Surgery of the spinal cord.  
D B PHEMISTER L. DRAGSTEDT G M CURTIS and C B HUGGINS—0 Surgical operations

## Wednesday

- D B PHEMISTER—0 Surgery of bones and joints  
P BAILEY G M CURTIS L. DRAGSTEDT and C B HUGGINS—0 Surgical operations

## Thursday

- G M CURTIS—0 Surgical operations  
D B PHEMISTER P BAILEY L. DRAGSTEDT and C B HUGGINS—0 Surgical operations

## Friday

- C B HUGGINS—0 Genito-urinary operations  
D B PHEMISTER P BAILEY G M CURTIS and L. DRAGSTEDT—0 Surgical operations.

## CHICAGO LYING-IN HOSPITAL

## Monday

- JOSEPH B DE LEE—2 Motion pictures of laparotomy

## Tuesday

- D A HORNER and L E NADELHOFER—0 Obstetrical clinic  
A R LAPHAM—2 Obstetrical clinic

## Wednesday

- J I GREENHILL and M F DAVIS—0 Obstetrical clinic

## Thursday

- E L CORNELL and M P UEBEN—0 Obstetrical clinic

## Friday

- J H BLOOMFIELD and H BUXBAUM—0 Obstetrical clinic

## SHIRINERS HOSPITAL

## Monday

- B H MOORE—2 Ward visit demonstration of apparatus in use

## Tuesday

- B H MOORE—0 Orthopedic operations use of ethylene anesthesia for children  
MR. DREHER—2 Demonstration of braces and special apparatus

## Wednesday

- B H MOORE and associates—2 Demonstration of plaster technique

## Thursday

- B H MOORE—0 Orthopedic operations  
B H MOORE—2 Moving pictures

## Friday

- B H MOORE—0 X-ray demonstration of unusual conditions  
B H MOORE—2 Results in orthopedic cases.

## ILLINOIS MASONIC HOSPITAL

## Tuesday

- JOHN R. HARGER—9 Infection of upper abdomen  
 ROBERT H. HAYES—10 Infection of the lungs  
 B. H. HUGGINS—11 Arthritis

## Wednesday

- GILBERT FITZPATRICK—9 Obstetrical surgery  
 WILLIAM H. GILMORE—10 Pelvic trauma  
 JOHN P. SPRAGUE—11 Orthopedic clinic

## Thursday

- HUGH V. MACKECHNIE—9 Gastro intestinal surgery  
 EDWARD A. WHITE—10 Genito urinary clinic  
 BAYARD HOLMES—11 Myocarditis and surgery

## Friday

- MORRIS BLATT—11 Thymus disease

NORTH CHICAGO HOSPITAL  
(At Grant Hospital)

## Tuesday

- FREDERICK HARVEY—9 Fracture clinic with special reference to fractures about the ankle and elbow

## Wednesday

- CARL BECK—9 Plastic surgery of the hands and fingers

## Thursday

- FREDERICK HARVEY—9 Thyroid clinic

## Friday

- CARL BECK—9 Hypospadias

## LAKE VIEW HOSPITAL

## Tuesday

- H. I. SANDERS—9 Surgery of the gall bladder demonstration of cases  
 B. C. CORBLES—2 Bladder tumors

## Wednesday

- ANDREW L. STAPLER—2 Thyroidectomies toxic adenoma with spinal block hysterectomies fibroids with spinal anesthesia

## Thursday

- JOHN W. BIRK—9 Obstetrical clinic presentation of pathological cases  
 WALTER S. SIEWERTH—2 Surgical correction of pathology of female genitalia

## JACKSON PARK HOSPITAL

## Tuesday

- ARRIE BAMBERGER A. HENNING and associates—9 General surgery  
 S. B. MACLEOD—2 Traumatic surgery

## Wednesday

- ARRIE BAMBERGER A. HENNING and associates—9 General surgery

## Thursday

- ARRIE BAMBERGER A. HENNING and associates—9 General surgery

## Friday

- S. B. MACLEOD—2 Traumatic surgery

## WASHINGTON PARK COMMUNITY HOSPITAL

## Tuesday

- C. C. CLARK—9 Thyroid operation carcinoma of breast  
 H. H. COX—9 Cholecystectomy hemorrhoids  
 Y. JORANSON— Blood transfusion spinal anesthesia  
 F. P. HAMMOND—2 Hernia recurrent and ventral management of fracture about ankle

## Wednesday

- S. C. HOGAN—9 Castic resection gall bladder surgery  
 L. B. BELL—9 Cholecystectomy posterior gastroenterostomy  
 C. C. COX—2 Hysterectomy carcinoma of breast thyroid  
 C. C. CLARK— Hernia gastro enterostomy

## Thursday

- F. P. HAMMOND—9 Osteomyelitis empyema  
 Y. JORANSON—9 Gout gastro-enterostomy  
 L. B. BELL—2 Appendectomy hemorrhoidectomy  
 S. C. HOGAN—2 Hysterectomy, thyroid

## POST GRADUATE HOSPITAL

## Tuesday

- L. GLASSMANN—9 I. rolapse of the uterus  
 W. SCHAARE—10 Colles fracture

## Wednesday

- LEO ZIMMERMAN—10 Vascular diseases of the extremities  
 W. A. N. DORLAND—2 Repair of perineum

## Thursday

- H. L. MEYERS—9 Hysterectomy  
 R. W. HADON—10 Injection treatment of varicose veins  
 EMIL RIES— Enterocoele vaginalis

## Friday

- EMIL RIES—10 Precancerous lesions of cervix uteri  
 M. MABEE— Treatment of leucorrhoea

## ST JOSEPH'S HOSPITAL

## Tuesday

- FRANK DAVID and C. J. DeBERE—9 Rectal surgery  
 W. H. G. LOGAN—9 Oral surgery  
 CHARLES MCKENNA—9 Genito urinary surgery  
 HUGH MCKENNA OSCAR O'NEER DAVID FITZGERALD and GEORGE FITZGERALD—9 General surgery  
 F. B. McCARTY E. I. CARROLL and JOHN BOLAND—9 General surgery  
 CHARLES SCHOTT—9 Results of Rammstedt operations for pyloric stenosis in infants  
 L. E. HINES—9 Demonstration of laboratory work as applied to surgery  
 W. F. GROSSENER H. BUNBAUM L. W. MARTIN T. J. O'DONOGHUE F. W. ROHR and G. COTTS—11 Gynecology

## HENROTIN MEMORIAL HOSPITAL

## Tuesday

- CHANNING W. BARRETT—9 Gynecological clinic

## Wednesday

- WILLIAM M. THOMPSON—2 Management of abdominal and pelvic adhesions

## RAVENSWOOD HOSPITAL

## Monday

- G W GREEN—2 Gallstone clinic  
G N BUSSEY—2 Abdominal hysterectomy fibroids  
G DE TARNOWSKY—2 Hemorrhagic colitis

## Tuesday

- C A BUSWELL—0 Carcinoma of the cervix uteri  
D B FOND—0 Fracture clinic.  
R E DYER—0 Fallopian tube visualization with lipiodol  
W F GROSVENOR C C KENTRO and F W ROHR—2  
Obstetrical conference

## Wednesday

- E B WILLIAMS—0 Abdominal hysterectomy, fibroids  
P J SARMA—0 Abdominal wall incisions based on physiologic grounds  
F VON NAWOWSKI—0 Hepatic abscess

## Thursday

- L WILDER—0 Gout cases  
E W MUELLER—0 Treatment of burns  
W F GROSVENOR C C KENTRO, and F W ROHR—2  
Obstetrical conference  
G DE TARNOWSKI—0 Ruptures of urinary bladder

## Friday

- G W GREEN—0 Surgical clinic.  
A G SCHROEDER—0 Surgical clinic

## ST BERNARD'S HOSPITAL

## Monday

- WILLIAM EPSTEIN—2 Gout clinic  
G M CUSHING—2 Gall bladder clinic

## Tuesday

- WILLIAM HECTOR—0 Surgical clinic  
L B DONALD—0 Surgical clinic  
CHESTER GUY—2 Laboratory demonstrations  
J A PARKER—2 Surgical clinic

## Wednesday

- J B HAEBERLIN—0 Surgical clinic  
EMIL RACH—2 Obstetrical clinic  
B C CUSHWAY—2 Radium cases

## Thursday

- J T MEYER—0 Surgical clinic  
W H BOHART—0 Industrial surgery  
J G FROST—2 Fracture clinic

## CHILDREN'S MEMORIAL HOSPITAL

## Monday

- JOHN A GRAHAM—1 The acute abdomen

## Tuesday

- JAY IRELAND—11 The treatment of empyema in children

## Wednesday

- FREDERICK B MOOREHEAD—0 Cleft lip and cleft palate, cartilage transplants for the correction of facial deformities

## Thursday

- ALBERT H MONTGOMERY—0 Pyloric stenosis and intussusception general surgery of children

## ALBERT MERRITT BILLINGS HOSPITAL

## Monday

- LESTER DRAGSTEDT—2 Abdominal surgery intestinal obstruction

## Tuesday

- PERCIVAL BAILEY—0 Surgery of the spinal cord  
D B PHENISTER L DRAGSTEDT G M CURTIS and C B HUGGINS—0 Surgical operations

## Wednesday

- D B PHENISTER—0 Surgery of bones and joints  
P BAILEY, G M CURTIS L DRAGSTEDT and C B HUGGINS—0 Surgical operations

## Thursday

- G M CURTIS—0 Surgical operations  
D B PHENISTER P BAILEY L DRAGSTEDT and C B HUGGINS—0 Surgical operations

## Friday

- C B HUGGINS—0 Genito urinary operations  
D B PHENISTER P BAILEY G M CURTIS and L DRAGSTEDT—0 Surgical operations

## CHICAGO LYING-IN HOSPITAL

## Monday

- JOSEPH B DE LEE—2 Motion pictures of laparotomy chelotomy

## Tuesday

- D A HORNER and L E NADLHOFFER—0 Obstetrical clinic  
A R LAPHAM—2 Obstetrical clinic

## Wednesday

- J P GREENHILL and M E DAVIS—0 Obstetrical clinic

## Thursday

- E L CORNELL and M P UNVES—0 Obstetrical clinic

## Friday

- J H BLOOMFIELD and H RUXBAUM—0 Obstetrical clinic

## SHRINERS HOSPITAL

## Monday

- B H MOORE—2 Ward visit demonstration of apparatus in use

## Tuesday

- B H MOORE—0 Orthopedic operations, use of ethylene anesthesia for children  
Mr DREHER—2 Demonstration of braces and special apparatus

## Wednesday

- B H MOORE and associates—2 Demonstration of plaster technique

## Thursday

- B H MOORE—0 Orthopedic operations  
B H MOORE—2 Moving pictures

## Friday

- B H MOORE—0 X ray demonstration of unusual conditions  
B H MOORE—2 Results in orthopedic cases

## EYE EAR NOSE AND THROAT HOSPITAL

## Monday

- A R. HOLLENDER—2 Physical therapy clinic practical demonstration of the application of electrotherapy to the eye ear nose and throat  
 T S. KAMMERLING—2 Eye clinic  
 H B. FULLER—2 Ear nose and throat clinic  
 IGNAZ SOMMER—4 30 Intracranial relation to ear nose and throat

## Tuesday

- H B. FULLER and D C. BROWN—9 Ear nose and throat surgical clinic  
 O B. NUGENT—11 Surgical treatment of chronic dacryocystitis  
 W A. FISHER—Simplified Barraquer operation for cataract extraction  
 R. CASTROVIEJO—4 Demonstration of various methods of ophthalmoscopy (simplified Cullstrand giant Cullstrand red free light direct and indirect)

## Wednesday

- T S. KAMMERLING and L. SAVITT—9 Ear nose and throat surgical clinic  
 O B. NUGENT—11 Photography as applied to the practice of ophthalmology Demonstration of making of photographic records in ocular diseases in plastic surgery Anterior stereopticon camera fundus photography making of lantern slides photomicroscopy Motion pictures  
 T S. KAMMERLING—2 Eye clinic  
 H B. FULLER—Ear nose and throat clinic  
 IGNAZ SOMMER—4 30 Tuning forks

## Thursday

- O B. NUGENT—9 Cataract clinic Cataract extraction by simplified Barraquer method teaching of cataract extraction by motion pictures  
 R. CASTROVIEJO—11 Practical demonstration of slit lamp microscopy  
 H B. FULLER—2 Eye clinic  
 T S. KAMMERLING—2 Ear nose and throat clinic  
 IGNAZ SOMMER, R. CASTROVIEJO and F. GALLARDO—2 Demonstration of various laboratory methods and the practical application of clinical findings  
 R. CASTROVIEJO—4 30 Histopathology

## Friday

- H B. FULLER, T S. KAMMERLING and O M. STEFFENSON—9 Ear nose and throat surgical clinic  
 H W. WOODRUFF—11 Deep incision for glaucoma tucking operation for strabismus  
 T S. KAMMERLING—2 Eye clinic  
 H B. FULLER—2 Ear nose and throat clinic  
 IGNAZ SOMMER—4 30 The role of the nasal accessory sinuses in nasal diseases

## LANKFORD HOSPITAL

## Monday

- FRANK J. NOVAK, JR.—2 Suspension laryngo copy

## Wednesday

- ROBERT H. BLACK—9 Demonstration of various eye operations

## CHILDREN'S MEMORIAL HOSPITAL

## Friday

- MORRIS COTTLE—9 Surgical and non surgical ear diseases in infancy

## RESEARCH AND EDUCATIONAL HOSPITAL

## Monday

- FRANCIS I. LEDERER, JOHN J. THEOBALD and OSCAR VAN ALVEN—2 Otolaryngological clinic

## Tuesday

- HALLARD BEARD—9 Surgery of squint tucking and tenotomy  
 NATHAN SCHNECK—10 Otolaryngological clinic  
 SHERMAN SHAPIRO and ARTHUR J. COOMBS—2 Otolaryngological clinic  
 FRANCIS I. LEDERER—2 Otolaryngological operations

## Wednesday

- I. G. SPIESMAN—10 Otolaryngological clinic  
 FRANCIS I. LEDERER, WALTER H. THEOBALD, and JOHN J. THEOBALD—2 Otolaryngological clinic

## Thursday

- GEORGE S. LIVINGSTON—10 Otolaryngological clinic  
 SHERMAN SHAPIRO and ARTHUR J. COOMBS—2 Otolaryngological clinic  
 JOHN J. THEOBALD—2 Otolaryngological operations

## Friday

- MAX L. TOLK and SALL C. GREENWALD—9 Plastic operations on the eyelids  
 J. HARNED—10 Otolaryngological clinic  
 FRANCIS I. LEDERER—2 Otolaryngological clinic

## MICHAEL REES HOSPITAL

## Monday

- M. L. TOLK—Diagnosis and treatment of iritis

## Tuesday

- SAMUEL J. MEYER—2 Operations for glaucoma

## Wednesday

- ROBERT VON DER HEYDT—2 Slit lamp microscopy of the living eye

## Thursday

- S. C. GREENWALD—2 Operations for strabismus

## Friday

- ROBERT VON DER HEYDT—2 Photography of the anterior segment of the eye

## MOUNT SINAI HOSPITAL

## Wednesday

- NOAH SCHOOLMAN, JACOB LIFSCHUTZ and associates—9 Broncho copy and lipiodol injections in pulmonary conditions esophagoscopy  
 NOAH SCHOOLMAN, JACOB LIFSCHUTZ and associates—2 Lipiodol studies and operations on accessory sinuses X ray studies and operations for ear conditions

## WASHINGTON BOULEVARD HOSPITAL

## Tuesday

- LENN E. MCBRIDE—2 Nose and throat clinic

## Wednesday

- CASSIUS and VIRGIL WESCOTT—2 Eye clinic

## Thursday

- LENN E. MCBRIDE—2 Nose and throat clinic

## SURGERY OF THE EYE, EAR, NOSE, AND THROAT

## ILLINOIS EYE AND EAR INFIRMARY

## Monday

MAYER H. LEBENSOHN and EDWARD H. CARRAGHAN—2  
Elastic surgery of eyelids  
U. J. GRIM—Mastoid

## Tuesday

HERBERT S. WALSH—2 Ocular muscles  
MICHAEL GOLDENBURG—2 Some late phases of glaucoma  
OSCAR CLEFF—3 Mastoid  
CHARLES F. YERGER—2 Radical nasal sinus operations

## Wednesday

DWIGHT C. ORCUTT and ROBERT H. BICK—2 Ocular  
muscles and operative trachoma  
HENRY JOETTCHER—2 Tonsils and mastoid

## Thursday

EPHRAIM K. FINDLEY—2 Cataract operations  
EDWARD N. SCHOOLMAN—3 Bronchoscopy and plastic  
surgery

## Friday

E. R. CROSSLEY—2 Cataract operations  
ALFRED LEWY—2 Nasal sinuses and mastoid

## RUSH MEDICAL COLLEGE

## Monday

WILLIAM C. REYDER—3 Ophthalmological clinic

## Tuesday

EARLE B. FOWLER—3 Ophthalmological clinic

## Wednesday

T. D. ALLEN—2 Ophthalmological clinic

## Thursday

WILLIAM C. REYDER—3 Ophthalmological clinic

## Friday

BERTHA ALLEN—3 Ophthalmological clinic

## IRLSBYTTERIAN HOSPITAL

## Monday

DANIEL HAYDEN—2 Far nose and throat clinic

## Tuesday

EDWIN MCGINNIS—2 Far nose and throat clinic  
WILLIAM H. WILDER—4 Eye operations

## Wednesday

GEORGE F. SHAMBAUGH—2 Ear, nose and throat clinic

## Thursday

EDWIN MCGINNIS—2 Far nose and throat clinic

## ST. LUKE'S HOSPITAL

## Tuesday

JOHN A. CAVANAUGH and EDWARD P. NORCROSS—Nose  
and throat clinics

## Friday

JOHN A. CAVANAUGH and EDWARD P. NORCROSS—Nose  
and throat clinics

## COOK COUNTY HOSPITAL

## Monday

JAMES P. FITZGERALD—3 Fundus clinic

## Tuesday

WILLIAM F. MONCRIEF—10 Diagnostic and operative  
eye clinic  
THOMAS J. GALLOWAY—10 Diathermy and malignancies  
of the mouth and throat  
CHARLES F. YERGER—2 Ophthalmoscopic and surgical  
clinic

## Wednesday

JAMES P. FITZGERALD—2 Ophthalmoscopic and surgical  
clinic  
S. SALINGER and S. LEARMAN—2 Diagnostic clinic—nasal  
plastic surgery

## Thursday

GEORGE W. BOOY—9 Bronchoscopic clinic  
CHARLES F. YERGER—2 Ophthalmoscopic and surgical  
clinic  
JAMES P. FITZGERALD—3 Fundus clinic

## Friday

JAMES P. FITZGERALD—2 Ophthalmoscopic and surgical  
clinic

NORTHWESTERN UNIVERSITY MEDICAL  
SCHOOL

## Monday

I. A. SHIFFER and E. F. DILLON—Chronic suppurative  
otitis media treated with zinc ionization  
JOHN DELPH—Endoscopy

## Tuesday

C. F. BOOKWALTER—Demonstration of intranasal tear  
sac operation

## Wednesday

OTIS MACLACH—Situs work  
WILLIAM JOYCE—Demonstration of plastic flap used in  
radical mastoid operation

## Thursday

CHARLES B. YOUNGER—Atrophic rhinitis

## Friday

R. D. KESSELL—Demonstration of endolymphatic sac  
and valve  
ELINOR I. ROSS—Vestibular reaction as affected by drugs

## JOHN B. MURPHY HOSPITAL

## Monday

G. W. MAHONEY—Emergency surgery of the eye in  
industrial injuries

## Tuesday

EDWARD CARRAGHAN—Operations for acute glaucoma

## Wednesday

S. SCARRETTA—Indications for operative treatment in  
acute mastoiditis

# SURGERY, GYNECOLOGY AND OBSTETRICS

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## THE THIRD INGUINAL RING<sup>1</sup>

A LEE MCGREGOR MB (EDIN) FRCS (ENG) M Ch (EDIN) JOHANNESBURG SOUTH AFRICA  
Sometime Head of the Department of Anatomy University of the Witwatersrand Assistant Surgeon Transvaal Hospital for children

FASCIÆ present problems of such profound interest that no excuse is necessary in submitting a thesis on so absorbing a subject. Bland Sutton (4) and others have shown that the higher the evolutionary plane of the animal, the more complex become the fibrous structures such as fascial planes and ligaments. Moreover reptiles and amphibians show little in the way of fasciæ or intermuscular septa. In man these structures reach a high development and much has been learned from human morphology by their study. Elliot Smith, Zuckerkandl, Proust, Schwalbe, Denonvilliers, Kirmisson, and others have by their investigations, solved many of the riddles presented by the pelvic fascial layers. It remains for others to elucidate with equal clearness, the fasciæ elsewhere. This work is an attempt to enable the superficial fasciæ of the lower abdomen and perineum to be better understood and to show that important surgical conditions such as ectopia testis may be explained on purely anatomical grounds.

The investigation embodied in this paper was instigated by a purely fortuitous circumstance. Reading one of the surgical periodicals, the writer met with an anatomical statement which seemed quite incorrect. On examining certain cadavers, he found that the remark in question was partially true. In pursuing the subject further he found it to be of such surpassing interest and practical impor-

tance that it was decided to make it the subject of a thesis.

The article referred to was written by Carl Goodwin Burdick, M D, and Bradley L. Coley, M D of New York, and is entitled "Abnormal Descent of the Testicle." As their article will be quoted from extensively the writer would like to pay tribute here to their careful anatomical observations and surgical deductions. Though disagreeing with many of their findings, they have yet pointed the way for these researches, and the writer is accordingly grateful to them.

Among other things they say "To gain a clear understanding of maldescent of the testicle, it is essential to appreciate the anatomy of the superficial fascia of the lower abdomen and groin. This consists of two layers, the superficial stratum called Camper's fascia and the deeper, Scarpa's fascia. The former passes downward in front of the spermatic cord and becomes continuous with the dartos of the anterior part of the scrotum. The latter, Scarpa's fascia, descends internally over the pubis and fuses with Colles' fascia of the perineum, laterally it passes over Pouparts ligament and becomes continuous with the fascial lata of the thigh and is also attached along the ramus of the ischium and pubis. If one's fingers are passed between the two layers (Camper and Scarpa) they easily enter the scrotum, but, if inserted behind the posterior layer they enter a space of loose tissue which

<sup>1</sup> Submitted and passed as a thesis for degree of Master of Surgery (Ch. M. Edin.)

## ILLINOIS CENTRAL HOSPITAL

*Tuesday*

- J H McLAUGHLIN—9 Ear nose and throat clinic  
H J SMITH—9 Emergency surgery of the eye industrial injuries

*Wednesday*

- J H McLAUGHLIN—9 Ear nose and throat operative clinic  
H J SMITH—9 Emergency surgery of the eye industrial injuries

*Thursday*

- J H McLAUGHLIN—9 Ear nose and throat clinic  
H J SMITH—9 Emergency surgery of the eye industrial injuries

*Friday*

- J H McLAUGHLIN—9 Ear nose and throat operative clinic  
H J SMITH—9 Emergency surgery of the eye industrial injuries

## WEST SIDE HOSPITAL

*Wednesday*

- W I NORLE—9 Surgery of the eye

*Thursday*

- J A CLARK and A E LUND—9 Tonsillectomies

## EVANGELICAL DEACONESS HOSPITAL

*Monday*

- ARTHUR GEIGER—2 Deflections of the nasal septum

*Tuesday*

- G THOMPSON and COLDITZ—2 Types of tonsil operations

## CHICAGO MEMORIAL HOSPITAL

*Monday*

- RICHARD H STREET—4 Tonsillectomies under local and general anesthesia

*Tuesday*

- ALFRED E LEWY and RICHARD W WATAIN—3 Mastoids  
IRVING I MUSKAT—4 Plastic surgery

## WESLEY MEMORIAL HOSPITAL

*Monday*

- T P O'CONNOR—2 Ear nose and throat clinic operations

*Tuesday*

- GORDON WILSON—9 Otolological surgery

## ILLINOIS MASONIC HOSPITAL

*Friday*

- T J WILLIAMS—9 Otolaryngological clinic  
W S BOYNTON—10 Scientific exactness in the differential diagnosis and operative treatment of strabismus

## ST JOSEPH'S HOSPITAL

*Tuesday*

- ALSTON A HAYDEN JACQUES HOLINGER and E W GARDNER—2 Eye ear nose and throat clinic accessory nasal sinuses

## POST GRADUATE HOSPITAL

*Monday*

- J HAYDEN—2 Accessory sinuses

*Tuesday*

- S SHER—11 Benign growth of vocal cord  
B CUSHMAN—2 Trephine for glaucoma  
W M WOLFE—3 Septum and tonsils

*Wednesday*

- E STEWART—9 Glaucoma

*Friday*

- S WIENER—9 Nasal polyps and accessory sinuses

## NORTH CHICAGO HOSPITAL

(At Grant Hospital)

*Tuesday*

- HARRY L POLLOCK—9 Surgical treatment of acute mastoiditis

*Wednesday*

- JOSEPH BECK—9 Surgical treatment of carcinoma of the larynx

*Thursday*

- HARRY L POLLOCK—9 Intranasal surgery

*Friday*

- JOSEPH BECK—9 Pathology of the ear nose and throat

## ALBERT MERRITT BILLINGS HOSPITAL

*Monday*

- D KATZ—2 Eye clinic

*Thursday*

- LOUIS BOTTMAN—9 Eye clinic

## COLUMBUS HOSPITAL

*Tuesday*

- C O LINDSTROM—9 Mastoiditis and various types of tonsillectomies

*Wednesday*

- L R MELLE—9 Plastics on nose

## RAVENSWOOD HOSPITAL

*Friday*

- A N MURRAY and W J NOONAN—2 Otolaryngological clinic

## CARFIELD PARK HOSPITAL

*Wednesday*

- R H GOOD and L B PHELPS—9 Eye and ear clinic

## MUNICIPAL TUBERCULOSIS SANITARIUM

*Thursday*

- FRANCIS LEDERER—2 Tuberculosis of the larynx and bronchoscopy demonstrations

## GRANT HOSPITAL

*Tuesday*

- O KRASY—9 Eye clinic

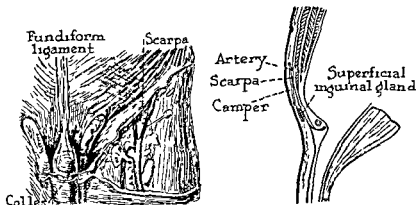


Fig 1 a (left) A dissection from Cunningham showing the fundiform ligament of the penis and fusion of the fasciae of Scarpa and Colles b Diagram of inguinal region showing the lymph vascular plane between the fasciae of Scarpa and Camper (modified from Cunningham)

membranous condensation. It is continuous above and below with the general subcutaneous fat, but over penis and scrotum is replaced by unstriped muscle. Between Camper and Scarpa lie the superficial arteries and veins, such as the superficial circumflex iliac, the superficial inferior epigastric, and the superficial external pudendal vessels, also the lymph glands of the groin, which latter structures never transgress the inguinal ligament.

The best account of the relation of this layer to that of Scarpa is that which the writer heard Professor Wright of the London Hospital give in 1919. He stated that these fasciae were inseparable over the lower abdomen except with the edge of a knife. He aptly compared them to a layer of surgeon's lint: that is to say, one layer in reality, the rough surface being Camper and the smooth surface being the membranous layer of Scarpa. This description exactly fits the fasciae over the lower abdomen, but over the base of the thigh they are easily separable because of the lymph vascular interposition. That a cleavage plane exists here is of moment surgically in relation to the upward path frequently taken by a femoral hernia (Figure 1b).

Professor Wright then went on to say that such a condensation occurred elsewhere in the body: (a) the fascia transversalis being merely an external condensation of the extraperitoneal fat, (b) the capsule of Gerota being an internal condensation of the perirenal fat and

ascribable to the effect of the pulsation of the kidney.

The dartos 'tunic' is described by Gray as follows: "In the male, Camper's fascia is continued over the penis and outer surface of the spermatic cord to the scrotum, where it helps to form the dartos, as it passes to the scrotum it changes its characteristics, becoming thin, destitute of adipose tissue, and of a pale reddish color, in the scrotum it acquires some involuntary muscular fibers and forms the dartos tunic. From the scrotum it may be traced backward into continuity with the superficial fascia of the perineum." This account agrees with that of other British textbooks. The French anatomists seemed to have realized more thoroughly that this muscle is in reality very large and extensive and not the vestigial structure it is usually considered to be in English speaking countries (Fig 2a).

The present research has shown that the muscle sometimes forms a complete investment for penis and scrotum. Displayed in a newborn male child, one is astounded by the extent of this muscle (Fig 3).

Penile dartos muscle commences at the pubic aspect of the root of the penis as a definite layer of reddish muscle which blends here with Camper and fundiform ligament. It extends in longitudinally arranged muscle fibers to the very tip of the prepuce and invests the entire projecting portion of the penis.



at first may give one the impression of being in the upper part of the scrotum, while actually the fingers are in the loose areolar tissue of the upper and inner thigh." It is this last sentence which was referred to as instigating this inquiry. It will be noticed that the writers consider that Scarpa's fascia passes behind the spermatic cord, or maldescent occurs.

It will also be seen that this description differs entirely from the usual account of the fasciæ as given in anatomy textbooks. So striking is the passage that the opinion of surgeons in this City was solicited about it. They agreed with the present author that Burdick and Coley were mistaken. The first specimen examined in the dissecting room showed a large fascial process *behind* the cord, which process was found to be a part of Scarpa's fascia.

The anatomy of the fascial planes of the scrotum and lower abdominal wall was therefore investigated. The writer has taught anatomy for 10 years, and must candidly state that the fasciæ in question have never been thoroughly understood by him. He has considered them as unpleasant to teach about and avoided the matter as much as possible. The impression he has received from other teachers leads him to conclude that they dislike the subject just as much. It would seem that these connective tissue sheets are ill understood generally, so much so that a congress of learned and famous anatomists while relegating Morgagni, Schwalbe, Zuckerkandl, Wisberg, and others to the realms of history, had sufficient respect for these fasciæ to leave them as they were, dignified by the names of Camper, Scarpa, and Colles. The subject of ectopia testis is obscure and not well understood, and is also of great surgical and economic importance. Anything which renders its etiology less obscure is necessarily important. It is hoped to show in the following pages that anatomical facts may go far to explain the situation if not the cause of the ectopic testicle.

Twenty cadavers have been examined. Fifteen were adult. These were all natives (Kafirs). Five were newborn or fetuses of 5 months and over, these were European. Dissection and injections of red lead were the

methods used. The work was confined to males. Entirely different factors obtain here to those in the female, in whom the fasciæ are of scant practical importance. It is hoped to pursue this aspect of the research at a later date.

The relations of 40 normal testes have therefore been examined, together with the fasciæ and perineæ. Subjects of all ages were used from young fetuses to old men of 80. Age in no way affects the findings which are common to all males. In fact, the fascial layers and pouches are better marked in newborn infants. It has been considered proper to deal serially with the various anatomical structures investigated. Subsequently the clinical and surgical bearings of the anatomical findings will be discussed.

#### ANATOMY

*The scrotum* is formed during the fourth month by the external genital folds which form the labia majora in the female (Keith).

About the end of the third week of development, when the limb buds have appeared, the mesoblastic cells of the limbs and body wall become grouped to form the bones (paraxial mesoblast), muscle plates, walls of vessels, and sheaths of nerves. The cells having become differentiated, numerous cells are left over which form the basis in which the specialized cells and groups of cells are packed and ensheathed. This undifferentiated mesoblast forms the fascial system of the body. From the nature of its development, obviously the connective tissue system of the body, which forms fasciæ and septa, must form a continuous sponge work of sheaths, each being in continuity with that of every surrounding structure. In view of the nature of the development of fasciæ it is entirely arbitrary to speak of the fasciæ of Camper, Scarpa, and Colles as separate entities. They form one continuous sheet with some little difference here and there which has led to this profusion of names.

The description of the fascia of Camper as given in textbooks of anatomy admits of little addition. Camper's fascia is that portion of the subcutaneous fat in relation to a variable part of the lower abdominal wall, which is bounded on its deep surface by a well marked

attached on each side to the corresponding body and ramus of the pubis. On the lateral side of the spermatic cord in the region of the groin, Scarpa's fascia ends immediately distal to the inguinal ligament by blending with the fascia lata of the thigh (Fig. 1a).

According to Burdick and Coley the testis and cord pass down into the scrotum in front of the fascia of Scarpa and behind that of Camper, i.e. between the two layers of superficial fascia. This is entirely contrary to all accepted anatomical teaching. The following description is based on the writer's researches.

Sir William Turner on being asked by a student where the sympathetic began, frightened him out of his wits by roaring in his deep voice "The sympathetic begins nowhere." Something of the same sort may be said of the fascia of Scarpa. Its upper limit shades so gradually into the subcutaneous fat that one cannot say exactly where it starts. It is certainly most variable in its extent upward and the degree of its development. Sometimes it may be traced well above the umbilicus. Laterally it disappears in a similar fashion in the region of the loins.

In color it is bluish or grey and in well covered specimens and babies its fibers may be seen separated by much fat and fibrous tissue. In these characters it differs from the fascia of Colles which is whiter, thicker, and has no fat. The fascia over the penis and scrotum in series with these fasciæ conforms to the description of Colles' fascia and should be so called.

Scarpa's fascia may be said to extend (1) medially, to fuse with the fundiform ligament of the penis, (2) distally (a) to the neighborhood of the root of the penis, where it fuses with the fascia of Colles—(b) to the third inguinal ring, where it fuses with Colles, and (c) to the fascia lata and pubic bone, as will be described. The fascia has no relation to penis and scrotum other than above described, unless Colles' fascia be considered merely as a name for a part of Scarpa's.

Over the lower linea alba it blends with a mass of tissue, the fundiform ligament, which binds Scarpa to the linea alba, so that there is a septum here between right and left halves of the fascia. It has no attachment to the suspensory ligament of the penis.

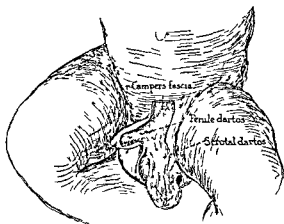


Fig. 3. Dissection of a newborn child showing an extensive dartos muscle, both scrotal and penile portions being perfect. The manner of replacement of Camper's fascia by the dartos muscle is shown.

An investigation of the relations and attachments of Scarpa's fascia at the root of the thigh discloses surprising facts of much practical importance in connection with ectopia testis. The attachments here are (1) lateral attachments, and (2) medial attachments—direct and reflected.

The arrangement of the lateral attachments is simple in the outer half. Here the fascia blends with the fascia lata a little below the outer half of the inguinal ligament. Quite as often it blends with the fascia lata actually where the latter meets the inguinal ligament (Fig. 1a). Frequently the most lateral attachment is to the fascia lata at the anterior superior iliac spine. This point is of some importance in connection with the position of the superficial inguinal ectopic testis.

In the inner half of its attachment at the root of the thigh, the fascia has medial attachments direct and reflected. As to the direct attachment, the fascia is attached just below the inguinal ligament in the region of the femoral vessels, its attachment then descends obliquely from the fascia lata to a point on the ischic pubic ramus about  $2\frac{1}{2}$  inches to 3 inches below the pubic spine. Along this line it blends with the fascia lata. Its attachment, therefore, crosses the femoral vessels, the adductor longus, and ends at the ramus on the gracilis expansion. The line of attachment crosses the fossa ovalis. The manner of crossing is variable. It may cross the upper or

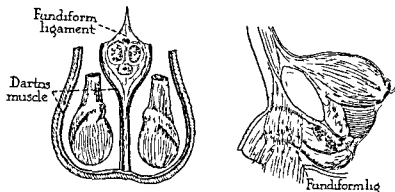


Fig 2 a (left) Diagram from Testut showing the constituent parts of the dartos muscle and the fundiform ligament of the penis b The fundiform ligament seen from the side

At the region of the third inguinal ring (*vide infra*) the yellow fascia of Camper suddenly changes to the red dartos, the scrotal dartos muscle. The transition is sudden and remarkable and well shown in Figure 3 taken from an actual dissection. The muscle completely invests the testis and its coverings except where the cord enters. It is big and powerful, its fibers are generally directed vertically in the long axis of the testis. The fibers arise from the skin on one side and are inserted into the septum of the scrotum or the layer of the fascia of Colles which covers the testis. Many of the fibers extend right round the longest circumference of the testis. The observer was profoundly amazed on first displaying the structure shown in Figure 3. That it possesses an important supporting function cannot be questioned. There are two layers of dartos in the scrotal septum, one from each testicular compartment. In the adult one usually sees an incomplete layer of pinkish fibers irregularly scattered over the testis. The dartos muscle can often be displayed over the adult penis. It is not usually looked for here. The muscle supports the testis and scrotum as a hammock and wrinkles the skin over the scrotum. This account applies to the dartos muscle and not to the subjacent membranous layer of superficial fascia. The dartos is in series with Camper's fascia and the subcutaneous fat on the perineum and bears the same relation to the subjacent fascia which Camper does to Scarpa. The simile of surgeon's lint is still ap-

plicable to the two layers of superficial fascia over penis and scrotum.

The dartos has as its deep relation a thick, strong membranous sheet of fascia continuous with the fascia of Colles below and that of Scarpa above. It will be shown later that this fascia is in all respects similar to the fascia of Colles rather than to that of Scarpa, and it should be included as a part of the former, although all three are continuous with each other. It should be emphasized that this is an entirely different structure to the dartos muscle despite their intimate relation and blending, and the term "dartos tunic" should be understood to represent two important penile and testicular coverings, the outer muscular, the inner membranous.

The fascia of Scarpa will be considered in great detail as it is one of the most important structures investigated in this research. The account given of it in different standard text books of anatomy and surgical anatomy are so similar that comparing or contrasting is unnecessary. The main points about the fascia as classically described are as follows.

Toward the lower part of the abdomen the panniculus adiposus develops a deep membranous stratum containing much elastic tissue. It is a relic of the elastic tunic of the lower animals such as the horse. In the region of the pubis it is carried continuously downward over the spermatic cords, the penis, and scrotum into the perineum where it becomes continuous with the fascia of Colles which is

Where this ligament (for simplicity called Scarpa's ligament) meets the direct attachment, there is formed an acute angle the sharpness of which is rounded off by certain arcuate fibers. Immediately above this angle the ilio inguinal nerve pierces the fascia of Scarpa usually as one, sometimes as two trunks. The greatest interest attaches to this arrangement of the reflected process of Scarpa. The ligament extends horizontally to fuse with the ligaments on the symphysis.

Of 20 subjects this ligament was found strong and well marked and forming a definite ridge 26 times. In 8 cases the arrangement of the reflected attachment was smooth and even. In the remaining 6 the ligament was rather membranous and formed a well marked edge about  $\frac{1}{2}$  inch below the upper border of the body of the pubis. In three bodies type 1 was seen on one side and type 2 on the other. This is an important observation.

It was further observed that a strong ligament on one side was sometimes associated with a membranous one on the other side (20 bodies enable the region to be examined in 40 cases). Great importance is attached to the fact that in the case of newborn babies and fetuses examined in this investigation, the reflected process of Scarpa was type 2 in conformation. This shows that the ligament is present in the fetus and does not develop in later life as the result of such factors as strain or weight lifting or the pull of the testicle.

It is further to be noted that there was a definite dimple behind the ligament in such young subjects. In a 5 months fetus, this ligament was big, very strong, and bilateral, with a definite recess behind it. All this indicates that it is not a development of post uterine life.

It is of vast and far reaching importance to notice that the reflected attachment of the fascia of Scarpa is behind the spermatic cord. Though faint and poorly marked at times, in most cases there is a strong process of Scarpa behind the cord. This is contrary to all accepted anatomical doctrines. Though nowhere referred to in anatomical books, reference to Figures 6 and 7 will show that the artists (who faithfully depicted dissections) represent portions of this reflected process of Scarpa passing

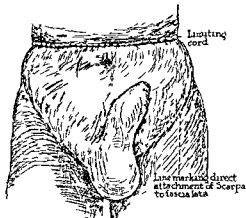


Fig. 5. An injection of red lead has been made under the fascia of Colles in the perineum. The direct attachment of Scarpa is well shown by the bulging of the superficial fascia. Penis and scrotum ballooned. Recently dead subject (24 hours).

behind the cord. Credit for this observation must go to Burdick and Coley, who, however, are wrong in the interpretation they place on it. Figure 8 borrowed from Burdick and Coley's article, shows the ligament formed by the reflected attachment of Scarpa with the cord passing anterior to it. This is correct. The author has never found the precise arrangement of the ligament which they figure, also they do not show the angle of fusion of the ligament with the direct attachment of Scarpa.

The scissors are in the pouch behind the ligament and in Figure 9 are shown in the areolar tissue over the adductors. They point out that anything pushed down behind the ligament would seem to enter the upper part of the scrotum, but in reality enters the root of the thigh between the ligament and the fascia lata over the adductors.

They also point out that it is impossible for anything entering here to enter the perineum. Entire agreement is expressed with this. It must be pointed out, however, that only by the use of considerable force or a sharp instrument can a passage be made behind the ligament. In all the cases examined where this pouch or ligament existed, there was found to be a strong fascial floor to the recess.

This floor is formed by the reflected attachment of the fascia of Scarpa. It is in view of these facts that the assumption made by Burdick and Coley that in crural ectopia the testis

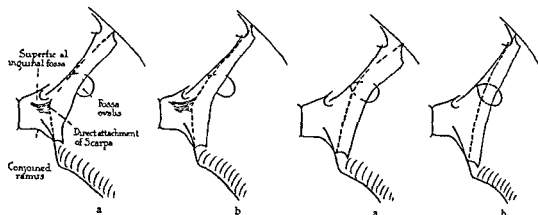


Fig 4. A diagram showing the method of attachment of Scarpa's fascia in Types 1 and 2. Note the direct and reflected attachments and the variation in position of the outer part of the direct attachment—see variable relation of the attachment to the fossa ovalis.

lower part of the fossa and obviously influences the relations of a femoral hernia. This point will be elaborated later (Fig 4). It will be seen that the line of fusion of the inner portions of the direct attachment of the fascia of Scarpa with the fascia lata is much below that given in textbooks.

The inner half of the fascia is stated to be attached to the inner half of the inguinal ligament (25), whereas its line of fusion is often a variable distance below this point. The fascial attachment descends about 1 inch to 1½ inches below and lateral to the pubic spine. The great importance of this will be pointed out later. There is, therefore, frequently an area above this fascial attachment where 2 inches of the adductor longus tendon may be palpated. Injections under Colles' fascia in the perineum show this as defined above to be correct (Fig 5).

What Burdick and Coley call the deep layer of the superficial fascia (Scarpa) of the lower abdomen, the writer ventures to call the reflected attachment of the fascia of Scarpa. Just as some fibers of the parietal layer of pelvic fascia end at the ischiopubic ramus, while others cross the pubic arch to form the superior layer of the urogenital diaphragm, so while some fibers of Scarpa's fascia gain a direct attachment to the fascia lata as indicated above, many of its fibers take a reflected course across the fascia lata, and while some are lost in the fascia lata, others blend with Poupart's liga-

ment, others sweep across to fuse with the ligaments on the front of the body of the pubis, and still others pass in over the adductors and are attached to the pubic ramus. It will be seen that these fibers of Scarpa pass down on the anterior abdominal wall to the line of the direct attachment and then bend sharply in ward toward the pubis. If this part of the fascia is to be called the posterior layer, it must be distinctly understood that by the anterior layer is meant the fascia of Scarpa passing down from the anterior abdominal wall and not the fascia of Camper as Burdick and Coley intend.

It is of great importance to observe that the fasciculi of the reflected attachment are directed horizontally for the most part. This reflected process while always presenting the same attachments differs in the appearance of its anterior surface. This difference is probably of profound importance in the etiology of ectopia testis.

In type 1 the reflected fibers sweep across to the pubis in a smooth unbroken line and the anterior surface of the process is flat and even.

In type 2 a fasciculus of the reflected attachment forms a definite ligament with an upper border which is usually horizontal but sometimes curved with its concavity upward and outward. Behind this border there is a depression which sometimes forms a definite fossa, which fossa is immediately below the outer part of the external abdominal ring.

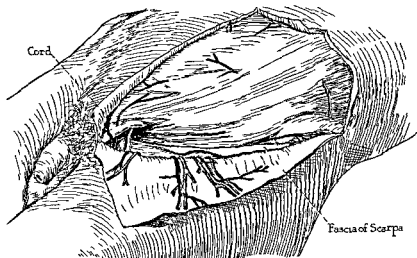


Fig. 7. A dissection from Ellis suggesting a process of Scarpa's fascia passing behind the cord

the superficial pouch of the perineum behind (Fig. 12)

The spermatic cord with its three coverings from the anterior abdominal wall lies anterior to this ridge to which the external fascia is attached. In the 5 months' fetus the scrotum is the size of a pea and not dependent, yet there is a definite cavity in it for the testis to occupy when it descends, and the reduplication of Colles' fascia, though not an even ridge as in the adult, yet forms a definite shelf which the testis must cross (Fig. 18). Next, the fascia of Colles is reflected over the testicle and up on to the anterior aspect of the cord, becoming continuous with the fascia of Scarpa at the third inguinal ring and joining laterally with the fascia of Scarpa where it passes down to its direct attachment to the fascia lata.

The projectile portion of the penis is invested with a complete sheath of Colles' fascia as far as the base of the glans. On or in this sheath lies the superficial dorsal vein of the penis and underneath the fascia a fibrous stratum separates it from the dorsal vessels and nerves (Fig. 10b). On the ventral aspect of the penis, there is a septum binding the fascia of Colles to the fibrous investment of the corpus cavernosum urethrae. The fascia of Colles covers the projectile portion of the penis exactly as a finger stall open at both ends covers a finger (Fig. 12).

Where the suspensory ligament joins the penis the fascia of Colles presents different relations in the adult and the young child. In the adult the fascia is fused with the fibrous penile coat beneath it in the form of a ring around the organ. In the child the fascia of Colles is not bound down on its deep surface but fuses with the fundiform ligament of the penis, the two meeting at a right angle, and there is a passage for fluid to reach the anterior abdominal wall when it passes upward from under the penile portion of the fascia of Colles. In the adult it is questionable whether this can happen unless the fluid be under sufficient tension to break through the layer of connective tissue which binds Colles to the underlying fibrous stratum just in front of the suspensory ligament. If in the child the fusion of Colles with the fundiform ligament will be lifted or divided, the suspensory ligament will be seen unattached to either of the former layers (Fig. 14). Passing from penis and cord to anterior abdominal wall the fascia of Colles fuses with the fascia of Scarpa.

Stress must be laid on the fact that the fascia of Colles which is superficial to the scrotal vessels and nerves and penile vessels and nerves is perforated in numerous places by small cutaneous branches of these.

As to the falciform process, the attachment of Colles' fascia to the conjoined ramus is not

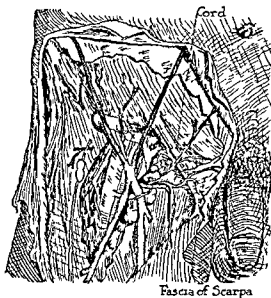


Fig 6 Drawing taken from Quain showing the fascia of Scarpa (green) winding round to the back of the cord

passes down behind this fascia must be considered untenable. In Figure 10a they show the attachment of the fasciæ of Colles and Scarpa to the pubic ramus, stating that a testis under the layer of fascia joining the ramus on the reader's right cannot possibly enter the perineum. This is agreed. They do not show the direct attachment of the fascia of Scarpa, and from the drawing it would seem that the layer they call "the posterior layer of fascia" is the fascia lata of the thigh. The reflected layer in this situation has a similar attachment to the pubis which the fascia lata has and is superficial to it.

Figure 4 shows type 1 and type 2 arrangements of the reflected fascia as found in this research.

Before leaving the fascia of Scarpa we should point out that in type 2 of the reflected process, the ligament going behind the cord holds the direct attachment forward, angulating it, so that the line of attachment is sharply convex toward the pubic spine.

The fascia of Colles as usually described is confined to the perineum, where it is attached to the ischiopubic ramus and the base of the urogenital diaphragm (Fig 11).

Cunningham states (conforming to all other descriptions) that toward the front of the penneum, the fascia of Colles is continuous with the Dartos tissue of the scrotum and that in its turn is continuous more anteriorly with the fascia of Scarpa. He states further that the bony attachment of Colles is prolonged upward as it becomes continuous with the fascia of Scarpa along the front of the symphysis pubis on each side. For reasons given above the writer considers the fascia of Colles to extend over the scrotum and penis deep to the dartos muscle.

Continuing, Cunningham states that the superficial pouch of the penneum is open above across the front of the symphysis pubis where its cavity is continuous with the areolar tissue filled interval between the superficial and deep fascia of the anterior wall of the abdomen.

Anteriorly the fascia of Colles passes over the scrotum, penis, and spermatic cords to the anterior aspect of the abdomen where it becomes continuous with the fascia of Scarpa. Note that Cunningham here definitely states that the fascia of Colles covers the genitals. The posterior scrotal vessels and nerves are immediately deep to this fascia. A more or less well developed septum dips down from the fascia of Colles to the inferior aspect of the bulb of the urethra.

The researches have shown some very important differences in the attachments of the fascia as described above and by other anatomists. The fascia will be described as consisting of two portions: (1) the general investing layer, and (2) the falciform process. Though this division is to some extent arbitrary, it is of great significance and valuable for descriptive purposes.

As to the general investing layer, from its nether attachment to the base of the urogenital diaphragm, the fascia extends up immediately under the subcutaneous tissue forming the lower wall of the superficial perineal pouch. Along a horizontal line a short distance above the head of the epididymis, the fascia is folded back on itself forming a well marked even ridge when the testis is dependent (the perineoscutal reduplication). This ridge bounds the entrance to the cavity for the testis in front and

The falciform process was found particularly strong, well developed, and forming a definite ridge on both sides in a newborn child. Notice that the thin sickle shaped edge forms but a very faint ridge above and a high prominent one in its lower part (Fig 16). It would therefore be negotiated with ease above, but with great difficulty below. Notice also that this process is not apparent until the attachments of the external spermatic fascia have been separated from it, though arching fibers may be seen on exposing the envelopes of the testis and cord from their lateral aspect. The arching fibers will be seen close to the pubic ramus gaining an attachment to this bone. The dissection to expose the process requires meticulous care in its performance or else the reflected process of the fascia of Scarpa and the fascia lata over the adductor longus may be torn through, in which case the sheath of the adductor longus will be exposed, and the fibers of the fascia lata going to the body of the pubis, which have a longitudinal direction, may be mistaken for the falciform edge. However, on tracing these fibers down they will be seen to continue down the thigh and not to fuse with the fascia of Colles (Fig 17). In one exceptional case certain fibers of the fascia of Scarpa were seen to cross the lower part of the falciform edge, passing down to gain an attachment to the testicular aspect of the fascia of Colles enveloping the scrotum. This was not found in any other case. So greatly did this falciform process intrigue the author that it was thought of the first importance to examine for it in fetuses at an age preceding the descent of the testis. The result of these dissections was further proof of the existence and function of the ledge. In the 5 months' fetus shown (Fig 18), the falciform process was seen to form a definite vertical ridge separating perineum from crural region. It conformed exactly in miniature to the state in the adult and was better seen because the testis with its coverings had not descended to obscure the process. This part of Colles fascia appears to be relatively stronger in the late fetus or early newborn child. Once again the strength and definition of the structure at so early an age would seem to bespeak for it some important function.

*The deep fascia of the perineum* Reference to any textbook of human anatomy discloses the fact both in the textbook and in the illustrations of the perineal region that on the removal of the fascia of Colles, the muscles of the superficial pouch are exposed, some areolar tissue intervening (Fig 11).

The author has repeatedly found that it is necessary to remove another layer of fascia before the muscles are reached. In this research this fascia has been found present in all cases, differing considerably in its development. At times the muscles are seen shining through it, but frequently it is very dense, strong and aponeurotic.

The deep perineal fascia blends behind the superficial transverse perineal muscle with the fascia of Colles and the urogenital diaphragm. It is attached at the sides to the ischiopubic ramus and extends on to the penis where it is continuous with a fibrous tunic of that organ, sometimes called the deep fascia of the penis. It, therefore, forms the first line of resistance which will be met by any extravasation of fluid deep to it. Near its base posteriorly it is sometimes perforated by the medial and lateral posterior scrotal nerves. Like the fascia of Colles it is perforated by small vessels in numerous places. Injections of a red lead solution made under the fascia extend on to the sides of the penis. The fascia confines the injection except where it is perforated by vessels and nerves, in which case it oozes out along these structures into the area just deep to Colles fascia.

It is bound down in the middle line on its muscular aspect to form a median septum. The author has called this layer the deep fascia of the perineum (Figs 19 and 20).

*The fundiform ligament of the penis* Morris describes this structure as arising from the linea alba and Scarpa's fascia just above the pubic symphysis. It forms a broad elastic band (superficial suspensory ligament of the penis) which sends a fasciculus on either side of the organ. Below the penis these fasciculi reunite. Testut and others state that after this reunion the ligament continues down into the septum of the scrotum (Figs 2a and 2b). The fundiform ligament has no attachment to the suspensory ligament of the penis.



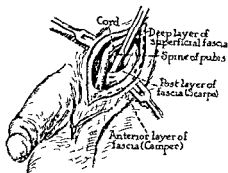


Fig 8 Dissection from Burdick and Coley The scissiors shown in the superficial inguinal pouch. The Ligament of Scarpa is in front of the scissiors and not the general layer of Scarpa's fascia as they have labeled it. What they label Camper's fascia is the general layer of Scarpa's fascia.

confined to the lower part of this bone, but extends upward nearly to the inferior aspect of the symphysis. This is represented accurately in Figure 15b, which is reproduced from an old edition of Morris' *Anatomy* (1893). Figure 15a from Fraser's *Human Skeleton* (1914), shows but a small bony attachment for the fascia. This attachment forms a complete septum between perineum and thigh for half the distance from the base of the urogenital diaphragm to the pubic tubercle. Above this mid point the fascia of Colles sends a peculiar falciform process upward to the region of the symphysis and this falciform process is the only structure (when the testis with its coverings have been removed) intervening between the upper part of the superficial perineal pouch and the area at the root of the thigh above the direct attachment of Scarpa's fascia. This process forms therefore not a partition between the two areas but merely a ridge. This falciform process continues the line of attachment of Colles to the pubic ramus, which it leaves before reaching the angle of the pubic arch to cross the body of the pubis and to blend with the ligaments of the front of the pubis and particularly with the external oblique aponeurosis with the fibers of which it is often directly continuous (Fig 16). This fasciculus of Colles is often composed of strong ligamentous fibers which seem by their size to have a supporting function as a sling for the scrotum. The falciform process is firmly bound

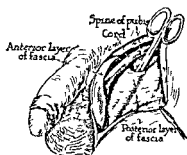


Fig 9 From Burdick and Coley The scissiors have been forced through the floor of the superficial fossa into the tissues at the root of the thigh. A testis cannot possibly take this route.

by its anterior edge to the external spermatic fascia covering the cord. When this is removed by careful dissection it becomes a free edge. The writer has been much impressed by the constancy of this fascial process and by its apparently important function in regard to both the support of the scrotum and ectopia testis. It is this fascial process which bounds the tunnel from the superficial perineal pouch to the anterior abdominal wall on the outer side.

If the testis and cord with external spermatic fascia be removed it will at once be seen that the falciform process forms a raised ridge between the superficial perineal pouch and the compartment at the root of the thigh between the fascia of Scarpa and the fascia lata (covered of course by the reflected process of the fascia of Scarpa). The direct attachment of Scarpa reaches and fuses with the fascia of Colles at the pubic ramus just below the point where the attached margin of Colles gives off the falciform process. It will be apparent on referring to the illustrations of dissections shown here that there is a well marked pouch between the fascia of Colles and the direct attachment of the fascia of Scarpa where they fuse at the pubic ramus. This is the crural or femoral pouch (Fig 16). It is remarkable how frequently the falciform process can be traced into the external oblique. Tendinous fibers of this muscle may be seen passing down into this process of Colles. Is it possible that the testis receives one of its main slings by insertion of external oblique into the fascia of Colles?

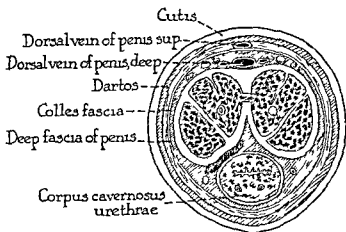


Fig 10b Transverse section of the penis showing the dartos muscle Colles fascia and the deep fascia of the penis which is continuous with the deep fascia of the perineum Note the position of vessels

bounds the third inguinal ring just about its lateral margin (Fig 25)

Only those coverings of testis and cord derived from the abdominal wall will be referred to here. These are the external spermatic fascia, the cremaster muscle and fascia, and the internal spermatic or infundibuliform fascia.

The external spermatic fascia is a prolongation of the external oblique aponeurosis which evaginated by the tunica vaginalis is its prolapse from the peritoneum. Usually described as a thin fascial layer subserving the function of ensheathing testis and cord, these researches amply demonstrate a much more active and important function for this aponeurosis. Figures 21, 21a, 23 and 27b show what would seem to be a constant finding.

Strong ligamentous fibers pass from the external oblique in the neighborhood of the external ring which gain a strong attachment to the fascia of Scarpa near the external ring. Strongly marked in the adult they are disproportionately larger and more powerful in the fetus and the newborn. These ligaments may be looked on as separate fibers of the external spermatic fascia and they serve the important office of holding the superficial fascia close to the external ring and of directing the structures passing down from abdomen to testis. This is made clear by the next figure (Fig 27b) which shows in a young

fetus these fibers binding the superficial fascia to the external oblique at a stage preceding the descent of the gubernaculum. This is a surprising finding and indicates an important function for these ligaments.

As the third inguinal ring is immediately below the external inguinal ring it will be understood that the ligaments which are attached to the anterior margin of the third ring (which margin is movable) serve to hold the orifice up toward the opening in the external oblique, and also hold the third ring open, so that the descending structures, having negotiated the abdominal wall, prolapse directly into this gaping hole.

These ligaments apparently precede the evagination of the external oblique as shown by Figure 27b.

The external spermatic fascia proper is firmly attached in the whole of its extent to the surrounding coverings on its outer circumference. Therefore it attaches to the fascia of Scarpa and Colles and also to the falciform process of Colles and the reduplication of this layer at the junction of scrotum and perineum. Anyone who has tried to deliver the testis at operation without first dividing its coverings will realize how firmly the external spermatic fascia is attached throughout its course. This layer may be considered an important sling holding up the scrotum through the external oblique above on the one hand and the super

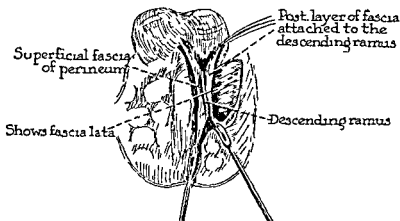


Fig 10a. From Burdick and Coley. Showing posterior layer of fascia (Scarpa) and Colles fascia. The underlying muscle suggests the possibility of the fascia lata having been raised and not the fascia of Scarpa.

They are entirely separate structures. It is a large band of fibrous and elastic tissue firmly attached to the lower 2 or 3 inches of the linea alba and the external oblique aponeurosis. Some fibers of the external oblique end in it. The fascia of Colles, the fascia of Scarpa and some fibers of the penile dartos fuse with it. In the young child it is of considerable extent and thickness. There is no difficulty in tracing it round the sides of the penis as a broad flat band or in showing how it enters the scrotal septum below (Figs 19 and 20). The relatively great size of this structure in very young babies is so striking that the relations of the ligament were examined with particular care. A discovery of great importance was made. In a 5 months fetus the ligament was exceptionally broad and strong considering the diminutive size of the specimen. The ligament was as thick and as long as the penis, but the point of greatest interest was the finding of a well marked fossa in relation to the ligament. This existed only on the right side and was bounded below by the dorsum of the penis, anteriorly by the fundiform ligament which formed a shelf which projected laterally for  $\frac{1}{8}$  inch posteriorly by the ligaments on the front of the pubis, and medially by the fundiform ligament extending down to the anterior abdominal wall and pubis. Laterally the fossa was opened. This

the writer has labelled the pubic fossa (Fig 27a). Its importance will be referred to later.

The suspensory ligament of the penis is a strong band of tissue, somewhat triangular in shape, which is attached to the symphysis pubis on the one side and to the deep fascia of the penis on the other. The dorsal vessels and nerves divide its penile attachment into two halves (Fig 14).

The ilio inguinal nerve bears very constant relations to the subcutaneous inguinal ring and to the spermatic cord. Unless it reaches the thigh by some devious route such as incorporation in the lumbo inguinal or lateral cutaneous nerve of the thigh, it invariably emerges lateral to the cord and passes for a short distance under the external spermatic fascia. It pierces the fascia of Scarpa as one or two trunks, carrying with it a strong sheath of external oblique through external spermatic fascia. When the reflected process of Scarpa's fascia sends Scarpa's ligament behind the cord this nerve is situated immediately above the angle of Scarpa. The pouch or recess above this ligament is bounded medially and above by the nerve with its sheath.

It is noteworthy that the ilio inguinal nerve with its sheath forms a strong ligament immediately below and to the outer side of the subcutaneous inguinal ring, and also

of Scarpa, the fascia of Colles and its falci form process

*Anatomical pouches normally found in the genital region* One of the foremost results of this investigation has been the discovery of certain pouches detailed hereunder, which the author thinks to be of profound interest and practical significance

The superficial perineal pouch is known to everyone Burdick and Coley say "By inserting the fingers behind the posterior layer of the superficial fascia (the fingers actually passing behind the ligament of Scarpa, as has been indicated above) they enter a space of loose tissue which gives the impression of being in the scrotum, while actually the fingers are in the loose areolar tissue of the upper and inner thigh" These remarks are applied to the normal cadaver This is the only reference made in the literature to a recess which might misdirect the testis in its descent It has been pointed out above that there is sometimes, in fact in about 50 per cent of cases a more or less well defined pouch in this situation

There are in and about the genital region five pouches the pubic pouch, the superficial inguinal pouch the crural or femoral pouch, the perineal pouch, and the scrotal pouch Three of these are always present, one is frequently present, and the remaining one has only been found in a 5 months' fetus

The pubic pouch was found on one side in a dissection of a 5 months' fetus It is shallow and lies just to one side of the mid line over the pubic bone (Fig 27a)

The pubic pouch is bounded anteriorly by a projecting shelf of the fundiform ligament and lateral to that of Scarpa's fascia—this shelf caused a projection much like that formed, by the peritoneum which forms the anterior wall of the paraduodenal fossa, and which contains the inferior mesenteric vein in its free edge

Posteriorly by the ligaments on the front of the pubis and the external oblique

Medially by the fundiform ligament

Laterally the fossa is open, and the external abdominal ring lies close to the open wall of the fossa

Superiorly, the fossa tapers to a point where the fundiform ligament meets the linea alba

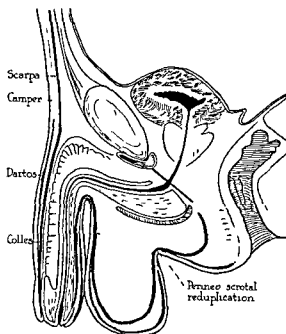


Fig 12 Diagram showing longitudinal section of penis Note the perineosrotal reduplication in adult and fetus (dotted line) The fascial planes and relations are indicated

Inferiorly, by the dorsal surface of the root of the penis It is in this situation that the fundiform ligament blends with the fascia of Colles

The superficial inguinal pouch was found in 26 of 40 cases It may exist on one side and not on the other It may be well marked on one side and slightly so on the opposite side It may be well developed or absent on both sides

It can exist only when a fasciculus of the reflected attachment of Scarpa's fascia forms a definite ligament (Scarpa's ligament) It has been shown above that this ligament usually has a horizontal upper border, though it is sometimes curved with its concavity upward and outward The fibers of the ligament blend with the tissue on the front of the pubis, the border fading away about half an inch from the mid line The length of the ridge is about an inch if well marked, but is often less It may be membranous or strong and ligamentous

It was well marked in the subjects before or just after birth giving the impression that the

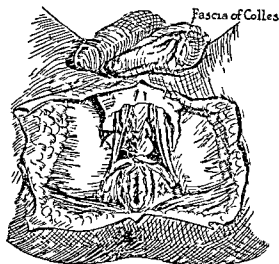


Fig 11 Dissection from Quain showing Colles' fascia and no trace of deep fascia of perineum

ficial fasciæ below on the other. Its inner surface is free and it is in this plane that the testis moves so freely up and down. It is this fascia also which is the main difficulty in defining the exact relations of the fascia of Colles.

The interesting cremaster muscle which arises in the angle between the lower border of the internal oblique and Poupart's ligament is inserted into the pubic tubercle, its fibers forming loops which descend over testis and cord. John Hunter, so justly honored for his great contributions to science, pointed out that this muscle would seem to serve as important a function in animals with testes normally abdominal, as in those whose testes become scrotal. He could not define this function, though he pointed out that in the former cases the muscle ascends behind the peritoneum to attach to the testis. In animals with scrotal testes it supports these organs and by the degree of its contraction determines whether the testes rest in the scrotum or higher. In children its excitability frequently causes mistakes in diagnosis, as the testis may be pulled temporarily into the subpubic region.

Hunter also pointed out that this muscle is much hypertrophied in people with a hydrocele of the tunica vaginalis testis.

A wrong impression of the size of the muscle is often obtained at operation where only a small part of it is exposed. It then appears to be represented by a few discrete muscle fibers. When fully exposed in the postmortem or dissecting room, it is seen to be a large muscle (Fig 22).

Little will be said about the internal spermatic fascia, except to point out that it is laminated and two or more layers may be divided before the structures it encloses are exposed. This was first pointed out to the writer by Professor D. P. D. Wilkie.

*The slings of the scrotum.* By the liberality with which nature has supplied the scrotum with supporting bands and ligaments, it would almost seem as though a far seeing Providence were providing so profuse a system of supports to prevent undue sagging should the scrotum have more to sustain than the testis. This occasion arises often enough whether the cause be a rupture, a collection of fluid, a granuloma, or a tumor. These slings are derived entirely from the superficial fascia assisted by the external oblique.

1. The scrotal dartos by its continuity with Camper's fascia and the manner in which this muscle surrounds the scrotal part of Colles' fascia acts as a muscular hammock.

2. Scarpa's fascia holds up the scrotum by means of (a) its fusion with Colles in the region of the third ring, (b) the direct attachment of Scarpa to Colles where they meet at the pubic ramus, (c) the occasional fasciculus of the reflected attachment of Scarpa described above, (d) the fundiform ligament which is an important support for the septum of the scrotum.

3. Colles' fascia. The falciform process acts as a strong ligament suspending the fascia of Colles from the pubis and anterior abdominal wall.

4. The external oblique. (a) The ligament binding this muscle to the fascia of Scarpa at the third ring, (b) the ligamentous fibers of the external oblique which pass down into the falciform process of the fascia of Colles, (c) the very strong support supplied to the scrotum by the diffuse manner in which the external spermatic fascia fuses with the fascia

structure, and situation It was noted above that the direct attachment of Scarpa's fascia in the thigh passed down with an oblique trend inward to meet the ischiopubic ramus and the fascia of Colles at a point just below the origin of the falciform process from the fascia of Colles, this point being about 3 inches or less from the pubic tubercle It is exactly here that the pouch lies

The crural or femoral pouch is bounded anteriorly by the fascia of Scarpa coming down as the deep layer of superficial fascia to the inner end of its direct attachment

Posteriorly, by the lower most reflected fibers of Scarpa going to the ramus and coursing over the fascia lata where it covers the expansion of origin of the gracilis

Medially, by the fascia of Colles where it forms the anterior wall of the outer part of the superficial perineal pouch Note particularly that only this fascia separates the fossa from this perineal compartment

Laterally, by the angle between the direct and reflected attachments of Scarpa

Superiorly, the fossa is open above into the wide area bounded medially by the falciform edge of Colles, and laterally by the direct attachment of Scarpa in its inner oblique part The pouch may be likened to the apex of a V Scarpa's and Colles' attachments just described forming the limbs of the V The open limbs of the V would direct into the apex anything descending from above

It is unnecessary to go into detail about the perineal pouch, by which is intended the universally recognized superficial perineal pouch This pouch is bounded anteriorly by the fascia of Colles which in the upper part of the pouch is reduplicated to form the shelf which leads into the scrotal pouch

Posteriorly, by the deep fascia of the perineum covering the superficial perineal muscles and perforated by certain scrotal vessels or nerves

Medially, the septum divides the pouch into two so that any solid structure entering this pouch from above, necessarily lies to one side of the mid line

Laterally, by the fascia of Colles below, and its falciform edge above, which latter separates this pouch from the crural one

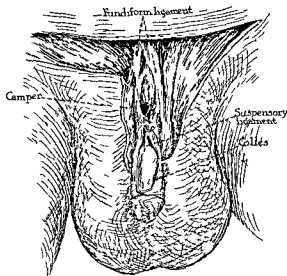


Fig 14 Enlargement of a dissection of a newborn child showing the fascia of Colles becoming continuous with the fundiform ligament at the root of the penis The arrow indicates a possible route for fluid The suspensory ligament is shown below this right angled junction

Inferiorly, the pouch ends by the fusion of Colles' fascia with the deep fascia of the perineum and the urogenital diaphragm

Superiorly, the pouch is open toward the anterior abdominal wall, by a canal which traverses the third inguinal ring

The perineal pouch contains the posterior scrotal vessels and nerves, perineal branch of the posterior cutaneous nerve of the thigh, and fat

The scrotal pouch is the actual cavity containing the testis Dissections of fetuses before the gubernaculum has descended show the pouch to exist at this early date (Fig 27a) It is unnecessary to go into detail about the scrotal pouch, except to point out that its posterior wall just above the head of the epididymis turns sharply back on itself to form the inferior boundary of the superficial perineal pouch, i e, the fascia of Colles, and that here is situated an even ridge dividing scrotal and perineal pouches In front of the ridge is scrotal pouch, behind it is superficial perineal pouch In the adult with the body erect, the angle formed by the meeting of perineal and scrotal portions of Colles' fascia is acute, in the fetus where the scrotum is not dependent, they form a right angle (Fig 12)

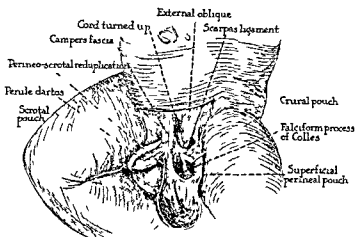


Fig. 13. Dissection of newborn child. See fascia of Camper, dartos ligament of Scarpa, falciform process of Colles and pouches.

fetal development exceeded that in the adult. The fossa is shown in Figures 17, 18, 27a, 27c, and others.

It is situated below and also lateral to the pubic spine, the external inguinal ring, and the inner portion of Poupart's ligament.

The superficial inguinal pouch is bounded anteriorly by Scarpa's ligament formed by certain of the reflected fibers of Scarpa's fascia.

Posteriorly by the reflected fibers of Scarpa's fascia going to the inner part of Poupart's ligament over the fascia lata.

Medially, the fossa tapers to a very acute angle, where the ligament blends with the pubis. The ilio inguinal nerve crosses above the floor of the fossa.

Laterally, the fossa opens by a mouth which is the widest part of the fossa. Great emphasis attaches to this point and to the fact that this outlet opens into a gutter formed by the fusion of Scarpa's fascia with the fascia lata and Poupart's ligament. This gutter has a smooth, even, unobstructed floor which runs outward with a slight upward inclination to the anterior superior iliac spine.

Inferiorly, the floor of the fossa is formed by fibers of the reflected attachment of Scarpa, which go to their inguinal and pubic destinations, and which, though in series with Scarpa's ligament do not project as it does, so that

the fossa results. This floor forms a strong fibrous area through which nothing can pass unless cut or other violence is used. The fact is again stressed that no case has yet been seen by the writer in which the finger could be passed behind the ligament through the floor of the fossa unless great violence was used. An easy way behind the ligament, which Burdick and Coley found, has never been found during this research. Although an instrument pushed through the floor of the fossa passes to the root of the thigh and not to the perineum, as pointed out by Burdick and Coley, the writer cannot conceive that a misdirected testicle could pass through the floor of the fossa.

Superiorly, the pouch is open upward as well as outward. It may present the appearance of a small slit or of quite a wide orifice. The important practical point is that just above the fossa is found the pubic tubercle, the external inguinal ring, and the medial end of the inguinal ligament. This fossa like the pubic one is situated immediately behind the deep layer of the superficial fascia of the anterior abdominal wall.

The position of the crural or femoral pouch is difficult to describe in words, but immediately apparent in the drawings taken from the actual specimens (Figs 13, 16, 18-16 etc.) It is remarkably constant in relation,

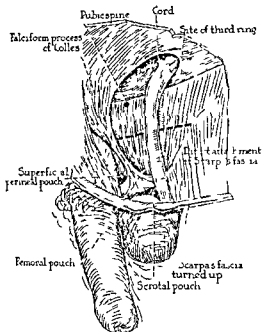


Fig 16 A dissection showing the type 2 attachment of Scarpa's fascia. No ligament of Scarpa and therefore no superficial inguinal fossa exists. Note the relation of the cord to the pubic spine the scrotal superficial perineal and femoral pouches. The dotted transverse line represents the site of the third inguinal ring—the funnel shaped type

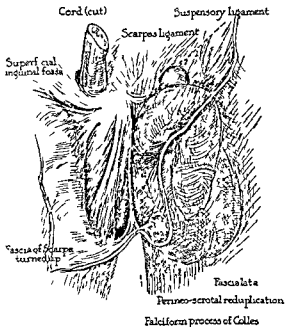


Fig 17 A dissection. The fascia of Colles is reflected on the right. The reflected process is torn through below the ligament of Scarpa showing a process of fascia lata which might be mistaken for the falciiform process of Colles which adjoins it on the left

holding it up toward the opening in external oblique (Figs 21, 21a, 27b). This is especially noticeable in babies and fetuses. Obviously these bands serve to hold open the orifice as well as to hold it up toward the external ring. Figure 25 is an actual drawing from a dissecting room subject in which the superficial fascia had been thrown down by the dissectors working in that region. Though a strong ligament is seen behind the cord and a well marked third ring exists, it is not the ring shown in the picture. The external spermatic fascia has been torn from the external ring but is attached to the third ring below, and it is this attachment which shows as a ring in the drawing.

This, of course, is an artefact and is reproduced here to point out how an error may arise in defining the ring.

If now the external spermatic fascia be separated the third ring will come into view.

As to surface marking, this opening is represented in the adult by a horizontal line

drawn outward from the middle line for an inch to an inch and a half to a level three quarters inch below the pubic tubercle.

Clinically, a finger invaginating the scrotum to feel the external ring, passes through the third ring, the boundaries of which may be defined thus. Medially is root of penis and suspensory ligament, and laterally the ligament of Scarpa or the "gutter" alluded to. The cord is often felt lying in this gutter. When the neck of the scrotum is palpated clinically, the soft silky skin of this structure will be found to change abruptly at the upper part of the scrotal neck to the thick elastic skin of the lowermost part of the abdomen. This difference is still more apparent when the scrotum is invaginated through the third ring. The site where this abrupt transformation occurs is the third inguinal ring, and here Camper gives place to dartos and Scarpa gives place to Colles.

In the adult these are the structures passing to and from the testis together with the cover-



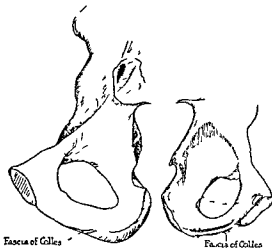


Fig. 15 a (left) Right *os innominatum* showing the extent of the fascia of Colles attachment to the conjoint ramus according to Fraser b From an old edition of Morris's *Anatomy* showing a much more extensive attachment for Colles's fascia to the hip bone This the present author thinks the more correct

Observations of the first importance may be made in regard to the crural, scrotal, and perineal pouches. They are all constant, they lie very close together, and two ridges namely, the falciform process of Colles and the perineo-scrotal reduplication of Colles are responsible for the formation of the fossæ.

This is well shown in dissections of all ages adult, newborn, and fetus (see Figs 13, 16, 17, 18 24, 26, 27a).

*The third inguinal ring.* In the course of its hazardous journey from the posterior abdominal wall to its scrotal destination, the testis must first negotiate the narrow defile formed by the inguinal canal this stage safely completed, it must cross a small strip of no man's land and then pass through a gateway which gives admittance to the scrotum. This gateway the author has ventured to call the third inguinal ring.

Passing reference has been made to this orifice in the foregoing. It is situated immediately to one side of the mid line and half to one inch below the horizontal level of the upper border of the body of the pubis and the external inguinal ring in the adult. In the fetus it is immediately below these structures.

A definite ring exists only in those cases in which the reflected process of Scarpa's fascia forms a well marked ligament. When this is absent the outer boundary of the ring is necessarily missing, giving the opening a funnel shape. The entrance of the scrotum presents, therefore, one or two varieties of conformation.

In type 1 (Figs 23 26, 27c) the size varies from 1 to 1½ inch from medial to lateral boundaries, from ½ to ¾ inch from anterior to posterior boundaries. It is circular or oval in shape. The plane of inlet is horizontal. It is bounded anteriorly by the fusion of the fasciæ of Scarpa and Colles which are here continuous with each other. Anterior to these, Camper is giving place to the dartos muscle.

Posteriorly, by the ligaments and bone of the pubic body medially Scarpa's ligament laterally (when present). Behind this band is the superficial inguinal pouch. Running up over the inner part of this boundary is the upper portion of the falciform process of Colles' fascia.

Medially, by the fundiform ligament and the root of the penis. The latter forms a ledge especially noticeable in the fetus.

Laterally, is situated a well defined sharp edge formed by Scarpa's ligament. The angle formed by this ligament and the general layer of Scarpa's fascia which gives off the ligament is fairly acute. This acuteness is rounded off by arcuate fibers. Immediately above this angle is the ilio inguinal nerve, which heightens the lateral boundary of the opening a small gap intervening between nerve and orifice.

Particular attention is directed to the fact that this opening is not seen immediately superficial fascia is raised from anterior abdominal wall, as is done in hernia operations. Like the external inguinal ring, this one is apparent only when the external spermatic fascia is removed. Now this fascia is attached fairly generally to the circumference of the ring particularly in front, though but slightly behind.

The ligaments which external oblique gives to Scarpa's fascia (described above) are attached to the anterior margin of the ring.

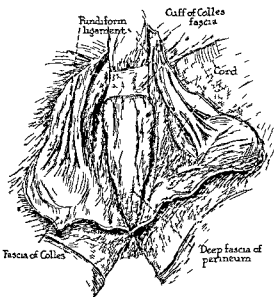


Fig 19 Dissection of perineum. Note the deep fascia of the perineum with red lead injection under it

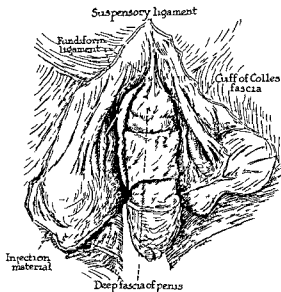


Fig 20 Dorsal view of dissection shown in Figure 19. Note injection material spreading along crus penis under fascia of penis

As the theory serves to explain the other wise inexplicable it is generally used for teaching. Lockwood in support of this theory says "It is irrational to deny this element its function, namely, that of contraction."

In searching for this structure or its remains in the adult one may find a nodule of tissue incorporated with the lower pole of the testis and its tunica. Just as often nothing is found. In cases of ectopia there is frequently tissue attached to the testis which is taken to be the gubernaculum. Such a structure unquestionably exists, but it is seriously open to question if it performs the functions so long accredited to it. In a 5 months' fetus an extremely interesting condition of the apices of the gubernaculum was found. On the left the structure had emerged from the external ring and its apex had surmounted the hither wall of a well marked superficial inguinal pouch. On the right it was not quite so far advanced and the delicate apex was arrested in the right superficial inguinal pouch. These conditions are shown in Figures 27a and c, and will be referred to later.

The spermatic cord is usually described as passing over the pubis on its way to the scrotum (\*). In surgical textbooks the rela-

tion of inguinal and femoral hernia to the pubic spine is one of the chief points in the differential diagnosis between these two types of rupture (34). "The most reliable method of differentiation (between femoral and inguinal hernia) is to recognize that the neck of an inguinal hernia lies above and medial to the spine of the pubis, while that of a femoral hernia lies below and lateral to the spine."

Discussing this classical statement Souttar says "This statement does not, however, rest on a very secure basis of anatomical fact, for an examination of any normal male will show that the spermatic cord either crosses the pubic spine or lies external to it, crossing the inner extremity of Poupart's ligament, and this remains the natural position of an ordinary oblique hernia. It is, however, true that the pubic spine is most readily palpated from the outer side of an inguinal hernia, by displacing the latter inward and upward, and from the inner side of a femoral hernia." The writer, since reading Souttar's article, has been at pains to investigate this point. He can amply corroborate the truth of the statement.

In every one of the cases examined during this research, the cord was situated lateral to

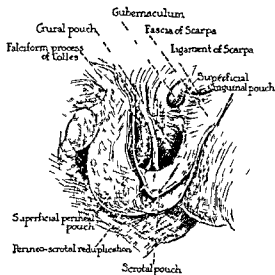


Fig 18 Dissection of a 5 months fetus. Note the gubernaculum which has evaded the superficial inguinal pouch. See also the crural and superficial perineal pouches and a well marked scrotal pouch (largely cut away) though the testis has not left the external ring.

ings they derive from the abdominal wall. In the fetus before the descent of the gubernaculum, the ring is well formed, patent, held widely open by ligaments from external oblique, and is empty (Fig 27c). Observe that this orifice leads not only to the scrotum but also to the perineal and crural pouches.

In type 2 the ring is funnel shaped. In this variety the entrance to the scrotum is wider as the lateral crus of the ring (Scarpa's ligament) is absent. The other boundaries are the same. Laterally there is the gutter formed where the fascia of Scarpa gains its direct attachment to the fascia lata of the thigh. Therefore, instead of there being a prominent sharp margin here, there is a gently sloping gutter. There is here no ledge to deflect outward anything solid which is trying to enter the scrotal gateway from above. On the contrary, the lateral gutter would tend to direct any such body into the scrotum. This type of opening is shown in Figure 16.

The gubernaculum testis or chorda gubernaculi has received an amount of attention out of all proportion to its size and possibly to its importance. It is not a part of this research to deal at length with this body. It

is alluded to mainly because it has been held almost universally to play a major part in the normal or ectopic descent of the testis. John Hunter, in 1762, gave this title to the tissue under consideration and gave the first account of it, being stimulated thereto by a case which his brother encountered of a 7 months' fetus with abdominal testes. Neither of these two could explain the fact, and thus his research was inception. He was further stimulated by the publication in 1755 of Baron Haller's *Opuscula Pathologica*. Not the least monument to the colossal genius and scientific acumen of John Hunter is the fact that his account of the gubernaculum testis is still the best extant. Much work has centered around the subject and Keith, Berry Hart, McAdam Eccles, Coley, Mixter, Bevan, Gowen, Godard, Curling, Lockwood, and others have made valuable contributions to the subject. All that is known of fact was elucidated by John Hunter, and though many theories about and yet about have come and gone Hunter's theory of the cause of non-descent is today once again the most popular one.

At the end of the second month of intra uterine life the gubernaculum appears. At that stage it is an actively growing cellular mesenchymal condensation.

Though no muscle is apparent at this stage this tissue is regarded as being premuscular (36). Striped and unstriped muscle fibers replace this tissue. The gubernaculum is then triangular, base above, apex below, the fibers being directed in its long axis. The apex is credited with the ability to excavate a path for the testis. Figure 29 is reproduced from Hunter's original one. According to some it grows rapidly through the inguinal region, according to others the inguinal canal is formed round the gubernaculum. It was Lockwood in 1887, who postulated a subdivision of the structure into six tails after its emergence at the external ring. One of these went to the scrotum, the others going one to each of the commoner sites of the ectopic testis. Though most ingenious, there is no corroborative evidence embryological or anatomical to support this contention (31). Others say definitely that these tails exist normally at one stage of development (15, 36).

It is usually understood from anatomical descriptions that perineal extravasations extend underneath Colles' fascia. Experimentally it is found that though this occurs to some extent, it is overshadowed by the amount of infiltration of the cellular tissue which occurs. This is plainly indicated by the Edinburgh surgeons quoted above.

When dissecting a part injected in this way, it is found that the superficial tissues have a myxomatous jelly like appearance, due to the amount of fluid in the tissue spaces. This agrees exactly with the state of affairs found when incisions are made for extravasation of urine. The knife cuts through  $\frac{1}{2}$  inch or more of sodden, boggy tissues before it reaches the collection under the deep layer of the superficial fascia. This fact accounts also for the frequency with which sloughing of superficial tissues occurs in these cases. The scrotum and penis are infiltrated in precisely the same way. The fluid is enabled to reach this superficial cellular tissue along the branches of cutaneous vessels and nerves, which have to pierce Scarpa and Colles to reach their destinations.

Injections under the deep fascia of the perineum (when this is well developed) are fairly well localized by this layer. Extending back to the base of the triangular ligament laterally to the conjoined ramus, and forward on to the dorsum of the penis at the sides of the suspensory ligament (Figs 19, 20). When a fair amount of tension exists under the fascia, the fluid may be seen squirting alongside the vessels and nerves which pierce the deep fascia of the perineum (Posterior scrotal and small unnamed branches of perineal artery). When the fascia is strong if the urethra is ruptured proximal to it, and it itself is intact, it will be the first line of resistance to the fluid. As this increases it will reach superficial perineal pouch along vessels and nerve sheaths. In a similar fashion these structures will guide it to the subcutaneous cellular tissue, i.e. Colles, Scarpa, dartos, and Camper.

**Hernia and hydrocele** Indirect inguinal hernia is the commonest type of hernia. It may reach the scrotum on the first occasion of its descent, or only after it has existed some

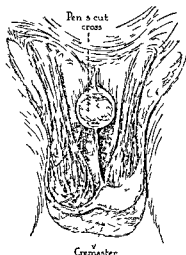


Fig 2 A picture from Spalteholz showing the cremaster

time as a bubonocoele. Every surgeon must have been impressed by the fact that these herniae frequently exist for many years without any great increase in size. Occasionally, particularly in the days before surgery became so aggressive as it now is, inguinal herniae sometimes increased to enormous dimensions. These had 'lost the right of domicile' (11). Such herniae were never common and are interesting. If now the slow rate of growth of an ordinary indirect inguinal hernia be compared with the rate of growth of umbilical (adult type) and scar herniae, it will be found that the rate of growth of the latter is very rapid by comparison. This is easily understood when it is remembered that the inguinal hernia is supported in the scrotum by two muscle systems and by the numerous slings which hold up this structure. It is likely that herniae which have forfeited the right of domicile result from a developmental weakness in the scrotal supports. In cases of infantile and encysted herniae the writer ventures to suggest that the peritoneal process which lies in front of the hernial sac or which the hernial sac invaginates is anchored to the third inguinal ring, having become adherent there for some unknown reason. It is known that the anchoring of the vaginal process occurs just beyond the external ring and this is also the situation of the third ring.

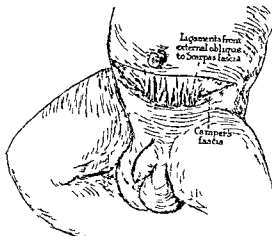


Fig 21 A newborn child, showing fascia of Camper and the ligaments passing from the external oblique to fascia of Scarpa and the third inguinal ring

the pubic spine. In no case was it medial. In babies it lay immediately outside the tubercle, in adults usually  $\frac{1}{2}$  inch lateral to this prominence (Fig 16).

If it be remembered that the inferior crus of the external ring is formed by the inguinal ligament and is horizontal, it will be easily understood that the testis on emerging from this orifice will tend to pass down over the inferior crus. On the living subjects clinical observation bears out these facts.

#### PATHOLOGICAL AND SURGICAL OBSERVATIONS

The anatomical findings stated in the foregoing gain their chief interest because of their practical applications. Certain surgical conditions affected by these findings will be discussed here briefly or at length according to their importance and their relationship to the research.

**Extravasation of urine.** Thomson and Miles (35) state that in rupture of urethra the common site—in front of or through the anterior layer of the triangular ligament—the urine infiltrates the cellular tissue of the anterior part of the perineum, the scrotum, penis, groins, and anterior abdominal wall. It is prevented from passing backward by the attachment of the perineal fascia to the base of the triangular ligament, and from passing

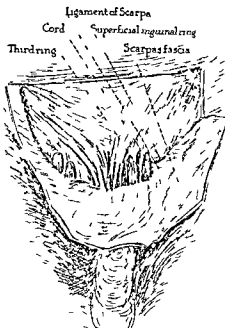


Fig 21a Dissection in the adult showing Scarpa's fascia turned down and numerous ligaments passing from external oblique to this fascia. On the left the ligaments are coursing over the cord to margins of the third ring.

down the thigh by the attachment of the deep layer of the superficial fascia of the abdominal wall to the fascia lata, along a line a little below Poupart's ligament. This investigation has brought out a few points of interest in connection with extravasation of urine due to urethral rupture at the usual site.

Injections of a red lead solution under Colles' fascia in the perineum were made. A band was tied tightly round the abdomen at the umbilicus in males recently dead (24 hours). The spread of the material defined the distal and lateral attachments of Scarpa's and Colles' fasciæ. In many cases the outer half of the attachment of Scarpa in the thigh did not extend below the inguinal ligament and the anterior superior iliac spine. In other cases the attachment was a little below this line. The inner half of its attachment in the thigh stood out in relief and corresponded to the oblique downward and inward attachment described for the direct attachment of Scarpa (Fig 5).

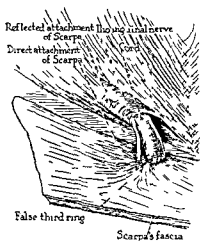


Fig 25 A student's dissection showing a false third ring

Scarpa crossing the saphenous opening. It is probably this type of case in which the swelling follows the superficial inferior epigastric. Here there is no fascia of Scarpa in front of it, and there should, therefore, be less resistance to its increase in size.

In hydrocele, hematocele, tumors of the testis in all of these conditions the scrotum has frequently to support a considerable weight. In spite of this it does not hang very low, and also even in large hydroceles, the apex of the swelling passes as a rule through the third ring. It was in cases like these that Hunter found the cremaster hypertrophied. This is further evidence of the supporting function of the muscles and slings of the scrotum and also of the efficiency with which they carry out their functions.

The etiology of varicocele like that of varicose veins is unknown. It is thought that some congenital weakness of the veins exists. One of the characteristic features of the condition is that the testis hangs very low on the affected side, another is the frequency with which it affects young adults soon after puberty, the third is the occasional presence of severe neuralgic pains. It is found that the dartos muscle is lacking in tone. The writer would suggest that either the testicular supports are developmentally inefficient or that the scrotum is slung too low, either conditions resulting in a constant drag on the cord and

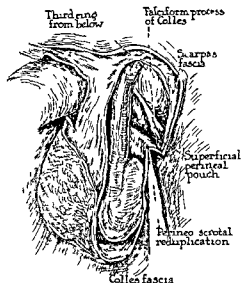


Fig 26 Dissection in an adult. Note third ring from below. See falciiform process of Colles, perineo-scrotal reduplication and pouches. The inversion of the testis is artificial.

on the pampiniform plexus. This would result in stagnation of blood and dilation of veins, it would also cause dragging on the ilio inguinal nerve which runs inside the cord for a short distance below the external ring. In this way pain in the distribution of the anterior scrotal nerves may be accounted for.

Nothing has been found in this research to account for the usual lower situation of the left testis or to explain the great preponderance of varicocele on the left side.

**Ilio inguinal neuralgia.** This is a rare condition. It does sometimes occur as a complication of varicocele. The pain radiates in the distribution of the nerve, i.e. upper part of scrotum and upper and inner thigh. The explanation given above is that the relatively unsupported testis in varicocele is more dependent and pulls on the nerve which runs inside the external spermatic fascia for  $\frac{1}{2}$  inch. In cases of ilio inguinal neuralgia, apart from varicocele, it is possible that some small degree of traction may be responsible.

**The imperfectly descended testis.** The publication of Baron Haller's *Opuscula pathologica* in 1755 led John Hunter to undertake his classic research into the descent of the testis. Since then an enormous mass of literature has

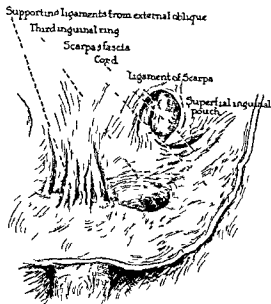


Fig. 23 Dissection of an adult Note the third inguinal ring Type 1 circular

Direct inguinal hernia is not common and remains a bubonocoele almost invariably. In the rather rare event where such a hernia reaches to the scrotum, it is of the type which leaves the abdomen lateral to the obliterated hypogastric artery and it must, to get into the scrotum, prolapse into the large sac of a pre-existent extensive indirect hernia. This combination of events must be excessively rare. If the rupture does not manage to enter such a sac the reason why it remains outside the scrotum is probably that it cannot negotiate the third inguinal ring, being prevented from so doing by the size of this orifice and its normal contents. The *falx inguinalis* also acts as a deterrent.

A rupture leaving the abdomen through the femoral canal, tends, when it attains a fair size to extend in an upward direction along the line of the superficial inferior epigastric vessels over the inguinal ligament. This is the classical description given, the reason adduced being that this is the line of least resistance.

This ascent is between the fascia of Camper and that of Scarpa. Now it is a well known fact that these herniae though they may attain

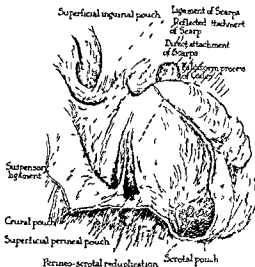


Fig. 24 Dissection of an adult Note falciform process of Colles Scarpa's ligament direct and reflected attachments of Scarpa's fascia and the constant pouches

the size of an orange usually remain small, which is one of the difficulties in their diagnosis. Reference to Figure 4 will show that the line of the direct attachment of Scarpa's fascia usually crosses the fossa ovalis obliquely from above downward and inward. There would seem on anatomical grounds to be two possible routes which might be taken by a femoral hernia which has reached the saphenous opening: (1) the hernia may pass above this oblique line and would then push the fibers of Scarpa which are reflected toward the pubis before it, it would then be compelled to pass upward and outward in the gutter between the direct and reflected attachment of Scarpa's fascia. Such a rupture would ascend gently upward and outward and would have two layers of Scarpa's fascia in front of it, the deeper being a reflected process of Scarpa, the more superficial layer being the deep layer of superficial fascia (Scarpa). This hernia would have a tendency to remain small because of the resistance offered to its growth by these strata. Once, however, it reaches the gutter it will be prevented from extending downward by the same reason which prevents the fluid extravasated under Colles from extending down the thigh. (2) The hernia may appear below the oblique attachment of

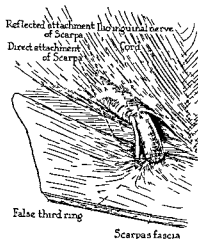


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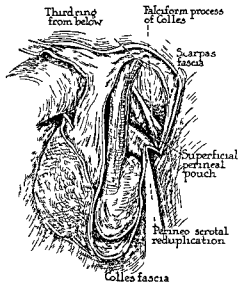


Fig 26 Dissection in an adult. Note third ring from below. See falciform process of Colles, perineoscrotal reduplication and pouches. The inversion of the testis is artificial.

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Ligament of Scarpa bounding  
superficial inguinal fossa      Gubernaculum  
Indirect fascia of Scarpa      Fundiform ligament  
Direct fascia of Scarpa      Pubic fossa



Fig 27a. Dissections in a 5 months fetus. The gubernaculum on right side is entangled in the superficial inguinal fossa. Note the rare pubic fossa.

grown up around this subject, and a great many ingenious theories have been mooted in explanation of it or its aberrations. One writer on the subject remarks that it is, in deed, a barren year which does not see the addition of at least one theoretical explanation of these phenomena.

It will be remembered that it was Hunter himself who gave the name of gubernaculum to the structure he invested with the function of causing the testicular descent. At the same time he suggested that the cremaster would be better called "the musculus testis." It seems strange that so wise a suggestion has never been carried into effect.

The gubernaculum theory has been amplified and occasionally altered somewhat but still remains vastly the most popular one in explanation of the migration of the testis. Curling was of opinion that the chief and only cause of descent is the gubernaculum.

Lockwood in his classical account, originated multiple gubernacular tails. By his careful anatomical researches in 1887 he was able to show several inferior insertions of portions of this structure. This has been very widely accepted and is very generally taught. Sonneland (31) questions this and finds no corroborative evidence embryological or anatomical for the existence of these tails. R. H. Hunter points out that in the newborn the testicle with its coverings and the tunica vaginalis can be lifted out of the scrotum without anything being torn, and argues that

if the gubernaculum is not attached to the scrotal tissues, obviously it can have no action in pulling the testis down. Coley was not altogether convinced by Lockwood's article. Championiere emphatically opposed the gubernacular theory and remarked that such a physiological explanation was antiquated and childish but ended up somewhat lamely by stating that nothing was known regarding the descent of the testis. Gowers, Godard, McAdam Eccles, Coley, Mixter, Eisendrath, Bevan, Sebileau, Budinger, and many others have made contributions to the subject.

Whether the testis has any intra abdominal descent is questioned by Sonneland and others. These consider that actual descent only begins at the internal abdominal ring, stating that degeneration of ten or eleven body segments causes the testis to attain this position.

John Hunter pointed out that all the pelvic viscera are higher in the fetus than in the adult. According to Sonneland (31) the inguinal canal is formed by the abdominal musculature developing around the gubernaculum and a process of peritoneum which becomes the process vaginalis.

The existence of the gubernaculum is too firmly established to admit of any doubt. What is questionable is whether it does function as Hunter suggested, and it is just as doubtful whether Lockwood's tails effect ectopia as intimately as he supposed.

According to Sonneland (31) the testis reaches the external ring through the agency of three forces acting together. These are intra abdominal pressure, intermuscular pressure, and active contraction of smooth muscle of the gubernaculum. Once beyond the external ring the only one of these three agencies which can be effective is the last.

According to R. H. Hunter it is the enlargement of the gut which is the main cause of the increase of intra abdominal pressure. He argues that as the gubernaculum has no inferior attachment the migration of the testis is entirely due to this pressure. Bland Sutton inclines to the opinion that migration is due to increase of intra abdominal pressure in late fetal life.

John Hunter must have considered increase of pressure in the etiology of descent as he

Ligaments from external oblique  
Fascia of Scarpa  
Superficial inguinal fossa  
Gubernaculum  
Ligament of Scarpa

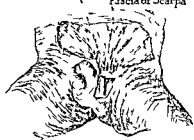


Fig 27b Fascia of Scarpa turned down showing ligaments holding third ring up to the external abdominal ring



Fig 27c The gubernaculum on left side has emerged from the superficial inguinal fossa and is about to prolapse into the third inguinal ring immediately below it

makes the important negative statement that as descent is complete before birth, respiration cannot affect it

Fraser (18) states that normal descent depends on the plica vascularis and the gubernaculum. While discountenancing the former as a cause of imperfect descent, he remarks that beyond doubt the abnormality lies in the gubernaculum. Recent work tends to favor some hitherto unsuspected reason for descent. Experiments with animals indicate that the extra abdominal position of the testes may be necessary to ensure proper temperature conditions.

This work being concerned with mal descent rather than with normal migration, the physiological side of the question will not be further discussed.

Imperfect descent of the testis is a general term which was first used by McAdam Eccles to include any departure from the normal descent of the testis. According to Eccles (13), imperfect descent includes (1) arrest of the testis at some situation in the normal route of its migration—(a) in the abdomen, (b) in the inguinal canal, (c) just below the external ring, (d) in the upper part of the scrotum (non-descent, partial descent, retention), (2) having emerged at the external ring the testis may deviate from the line of its normal route and go to (a) the perineum, (b) Scarpa's triangle, (c) the root of the penis, (d) between Scarpa's fascia and external oblique (mal descent, abnormal descent, ectopia).

Numerous explanations have been put forward to explain these abnormalities. It is not

within the province of this paper to discuss imperfect descent proximal to the external inguinal ring. Distal to that the testis may be (a) in the scrotum, (b) partially undescended, (c) ectopic.

Some abnormality of the gubernaculum is most generally held responsible for errors affecting migration from the external ring to the scrotal bed. Arrest of the testis between these two points is partial or incomplete descent. This has been ascribed to fracture or loss of function of the gubernaculum, under development of the scrotum, adhesions from the tunica to the surroundings (Budinger) and many other causes. Eisendrath ascribes it to faulty development of the muscles of the inguinal canal. Sonneland (32) speaks of atresia of the scrotal neck. Eccles mentions persistence of the plica vascularis, shortness of the spermatic vessels (much the same thing), shortness of the vas, faulty action of the cremaster, and he ventures the suggestion that the pressure of a truss may prevent full descent. Godard favored the view that imperfect descent was due to heredity and was supported by Uffreduzzi.

So in this way instances may be multiplied, the multiplicity of suggested explanations is the best proof of the insufficiency of any.

Coming now to the question of ectopia testis, opinions are quite divergent. Eccles, whose authority is great, states that there are probably only two conditions which may cause this: (1) abnormal gubernacular action, (2) which pushes it into an ectopic position. An advancing hernia behind the testis

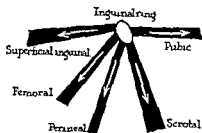


Fig #8 Diagram from Eisendrath (modified) showing gubernacular tails of Lockwood

Sonneland (31) states that the attachment of the ectopic testis, which is usually taken for the gubernaculum, is in reality a secondary attachment of the fractured gubernaculum, and advances what he calls an "accident gravity" theory. Briefly this implies a functionless gubernaculum, following the escape of the testis at the external ring, a long cord, the constancy of the fascial planes of the lower abdomen and perineum, and the operation of physical laws which govern a moving body. Some authors state that the site of ectopia is often determined by a fascial pocket, but beyond the bare statement, adduce no evidence in support of it.

The testis is said to roll in a fascial plane until it comes to a pocket which stops it. According to Burdick and Coley ectopia is often due to the testis passing posterior to Scarpa's fascia, these authors affirming that the normal path to the scrotum is between Camper and Scarpa. According to others the gubernaculum is normally attracted by the lymphatic tissue of the groin, and they assume that a congenital absence or abnormality of distribution of this lymphatic tissue is the original cause of the ectopia (quoted by Fraser, 19). It seems a strained explanation, as lymphatic tissue is more plentiful in the lumbar region where the testis develops than in the groin.

Because of the important function attributed to the gubernacular tails of Lockwood, it may be well to consider the present position of knowledge in regard to them.

Lockwood described the lower end of the gubernaculum as dividing into six processes. One of these passes to the normal terminus of the testis in the scrotum, a second goes to the

perineum, a third to the pubis, a fourth to the root of the penis, a fifth to the external oblique aponeurosis near the anterior superior iliac spine, and the sixth to Scarpa's triangle. He assumed the scrotal fasciculus to be the best developed, it would, therefore, overcome the other processes and thus the testis would reach its normal scrotal situation. Should it happen that one of the other processes was the largest and strongest, the testis would be pulled in that direction and become ectopic. In support of this, a well developed gubernaculum is often described in connection with the ectopic testis, and Coley and others have figured this. It has already been noted that some surgeons have thought that this represents a secondary attachment of a gubernaculum which has become fractured. Though one gubernaculum is often referred to, multiple processes are neither described nor figured at operating. If this structure has no intermediary insertion as R. H. Hunter claims it is quite justifiable to assume the ectopia to be due to some other factor, in which case the gubernaculum would follow the testis into its aberrant site. Opinions on the matter are, therefore, divided. The Langaroo has testes which are normally pubopenile in situation, the pig has perineal testes. Those who favor Lockwood's theory say that this is due to the penile tail in marsupials and the perineal tail in swine being the strongest. Figure 8, modified from Eisendrath, is a diagrammatic representation of these tails in the human being. The writer's own researches have failed to demonstrate any subdivision of the gubernaculum. When some writers deny the existence of any evidence, embryological or anatomical (Sonneland) for the existence of these tails and others peak of the evidence as being unconvincing (Coley) and others again deride the whole gubernacular theory as being childish and archaic (Championiere), it must be concluded that Lockwood's view is unproved.

Many of the opinions given in explanation of imperfect descent after the testis has left the external ring, are difficult or impossible to disprove. Were this not so the suggestions in question could have been ruled out. Lately John Hunter's original view has been revived,

namely, that imperfect descent is dependent on imperfect development of the organ. It is obviously impossible to disprove this, the more so as there is in all probability much truth in it. It is stated by many that whereas the retained or partially descended testis is deficient in development of the elements subserving its external secretion, the ectopic testis is usually fully developed. This is in favor of Hunter's view. Essendrath's opinion that the primary fault lies in the development of the posterior wall of the inguinal canal is equally difficult to dispose of. At operations for partial descent the commonest reason why the testis cannot be replaced in the scrotum is the lack of development resulting in the shortening of the mesoblastic elements of the cord. There would seem to be some ground for the idea that this incomplete descent is due to abnormal persistence of the plica vascularis. On the other hand it might be argued that this was secondary and not primary. The same remark applies to the theory that adhesions are the cause of the trouble. Atresia of the scrotal neck has been observed, and this would be an absolute bar to further descent.

It is uncommon so it cannot account for all cases. It may exist more commonly than is supposed for the reason that it is probably not looked for. Occasionally imperfect descent is associated with an absence of development of the homolateral half of the scrotum. This is much the same as atresia of the scrotal neck in regard to the obstruction to descent. Sonneland (32) makes allusion to fascial pockets of the cause of ectopia, but produces no evidence in support of this.

As to the anatomical explanation of imperfect descent of the testis after it has left the external ring although it must be conceded in the present imperfect state of knowledge that such factors as congenital shortness of the mesoblastic elements of the cord, shortness of the vas, or adhesions may conceivably interfere with normal and complete descent, the author is of opinion because of the results forthcoming in this investigation, that incomplete descent affecting the testis in its extra-abdominal course, and ectopia, are explainable on purely anatomical grounds. When structural conditions occur uniformly, or very

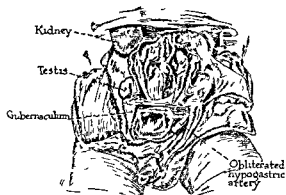


Fig. 29. Hunter's original drawing showing the gubernaculum in a case of abdominal testis in a 7 months fetus.

commonly which offer an explanation for these abnormalities, it is only rational to accept the natural explanation rather than some theoretical assumption which does not admit of proof. Therefore, the writer ventures to bring forward the following explanation to account for incomplete descent below the external ring and for ectopic testis.

Imperfect descent is due to one or more of the following factors: (1) congenital anomalies or absence of the third inguinal ring, (2) congenital fascial pockets, (3) congenital fascial ridges. To render this statement lucid it has been thought wise to deal somewhat fully with the subject of ectopia testis.

Ectopia testis may be defined as a congenital or traumatic anatomical anomaly which is characterized by the position of a testis which lies not only without the scrotum, but outside of the normal path of its descent (Sonneland, 31).

Frequency. Among 59,235 cases of inguinal hernia in males at the Hospital for Ruptured and Crippled, from 1890 to 1907 there were 737 cases of imperfectly descended testis. The American War Department, in the examination of Army recruits, found 8,538 cases of monorchism or synorchism. This gave a frequency rate of 3.1 per 1000 males examined. It was noted that the distribution in certain big areas was unequal, which led to the suggestion that some racial peculiarity might be causative. Rennes and Marshall reported 17 cases of ectopia in 14,400 recruits examined for the Army (8). Da Costa (12) states that

in one person out of one hundred there is either undescended or ectopic testis

Wrisberg says that 30 per cent of newborn male children have *undescended testes*. In most of these, descent is completed in the first few weeks after birth

There are four varieties of ectopia testis (1) superficial, inguinal or interstitial, (2) pubopenile, (3) perineal, and (4) crural or femoral

These are the usual types. Banks reported a case of *transverse ectopia of the testis*. The condition is extremely rare and of an entirely different nature from the variety under discussion. The right testis had made its way through the left inguinal canal having crossed the space of Retzius. Cases occur with extreme rarity if a crossing of the testes has occurred. Dichotomy of the testis is known to have occurred. In all these cases, entirely different factors come into play which do not affect ectopia in the ordinary sense

The superficial inguinal testis was described as being extremely rare. Coley who has operated on a big series of cases of ectopia states that it is the commonest type. It occurred 73 times in a series of 537 cases reported by Burdick and Coley

The testis lies lateral to the external ring, somewhere between this opening and the anterior superior iliac spine. Frequently it is just above and external to this ring. Like other forms of ectopia it is almost invariably associated with a hernia behind it. The common belief is that it is pulled here by abnormal development of a gubernacular strand

When the gubernaculum has emerged at the external ring it finds the third ring immediately below it. This ring is held open and toward the external ring by ligamentous fibers of the external oblique. It is the easiest route for the gubernaculum to take and the line of least resistance

In the event of the third ring being closed the force exerted on the testis, which is still in the canal is transmitted to the gubernaculum which may be deflected in some other direction. There are four possibilities

Should it go medially it will come in contact with the fundiform ligament. If the pubic

fossa exists the gubernaculum and testis may be ensnared in the fossa

If no fossa exists, it may continue to pass up and out and may come to lie just above the external ring. If, however, the gubernaculum is deflected out from the site where the third ring ought to be it will pass up in the gutter between the direct and reflected attachments of Scarpa. Along this gutter it may reach the anterior superior spine or fall short of this point. It has been shown that Scarpa in its outer half is often attached to the inguinal ligament and the spine. The attachments of Scarpa, therefore, direct the line of movement of the testis travelling in this way

The fourth possibility is that the emerging gubernaculum finding its way to the scrotum barred, may remain in contact with the site where the third ring ought to be most probably by contracting adhesions. In this case the testis has not been deflected from its normal path and becomes a case of incomplete descent. It is here repeated to emphasize an important point that the third ring and the testicular scrotal bag are normally well formed before the gubernaculum reaches these areas

These have been the consistent findings in this research. The gubernaculum, therefore has no tunnelling to do in this region but finds its way prepared. If the gubernaculum possessed the excavating property so generally attributed to it, there is no reason why it should not bore its way through any obstruction below the external ring. It fails to do this and becomes partially descended or ectopic

An obstructed third ring is one possible cause of interstitial ectopia. A second possibility exists. Figures 27a and c show the gubernaculum in different relations to the superficial inguinal fossæ on the two sides of a fetus. On the left side the apex of the structure has emerged from the fossa and has surmounted the ligament of Scarpa which forms the anterior boundary of the fossa and the posterolateral boundary of the third ring. On the right side the gubernaculum has not advanced so far and its apex lies in the fossa. It has been shown that in a large percentage

of cases a well defined fossa lies just below the external ring, which fossa is formed by a prominent ridge—the ligament of Scarpa. The advancing gubernacular apex falls into this fossa. No doubt it usually surmounts the ridge. However, should it fail to do so it will pass in the line of least resistance, which is toward the lateral open side of the fossa and so gain the gutter between the two attachments of Scarpa, and in this way lie on the external oblique aponeurosis somewhere in the situation occupied by the superficial inguinal testis, once the testis has reached this fossa, the ilio inguinal nerve is an additional bar to its return to its normal path.

The pubopenile type is rare. A case was reported by Sir Berkeley Moynihan who describes it as one of the rarest forms of ectopia. The left testis lay on the dorsum of the penis  $1\frac{1}{2}$  inches below the pubis. It is significant that the left half of the scrotum was imperfectly developed. Cairns Forsythe records and notes a second case, also from Leeds, which was operated on by Mr. Edward Ward in 1902. The testis was tuberculous. The condition of the scrotum is not referred to. Other cases of ectopia pubo penilis are on record. The testis rests in front of the pubis at the root of the penis, or on the dorsum anterior to the pubis.

One of the gubernacular tails is described as going to the pubis. This is held the responsible agent. It is however, hard to see how, with its pubic attachment, it could bring a pubic testis to a position  $1\frac{1}{2}$  inches anterior to the bore. Anatomically the explanation is simple.

The third ring being closed, and the gubernaculum direct medially it slides up alongside the fundiform ligament unless it meets the rare pubic fossa (Fig. 27a). In the latter case, it remains in the fossa where the testis follows. It may stay here to form an ectopic testis in contact with the pubis. The testis then rests on the dorsum of the penile root which is the inferior boundary of the fossa. Now it has been shown in the foregoing that the layer of the fascia of Colles ensheathing the penis continues proximally with the fundiform ligament at a right angle (Fig. 14).

The testis, therefore in the pubic fossa may slip down and pass under this fascial junction,

and the only bar to its progress along the penis is the length of the cord.

Anatomically there is no reason why the testis should not sag to the lateral aspect of the penis or even to its ventral surface, where it would be barred by the median raphe. Similarly with a sufficiently long cord it might advance to the reflection of the inner layer of preputial skin at the base of the glans. The writer would like to point out that a scrutiny of the delicately pointed gubernaculum on emergence from the abdominal wall strongly supports the assumption that this "feeler" would be easily deflected.

John Hunter described two cases of the perineal type in 1786. Curling gave the first detailed account of the condition in 1841 and collected 9 cases. He was the first to operate. The patient was 4 weeks old and succumbed. In 1879 Annandale performed the first successful operative cure.

Godard noticed 3 cases of perineal ectopia in 53 cases of imperfect descent. He mentions a case in which both father and son possessed perineal testis.

Klein reviewed the subject of ectopia. Among the 17 cases of ectopia in 14,400 recruits reported by Rennes and Marshall, not one was perineal. There were only 5 cases of perineal ectopia in 936 cases of imperfect descent associated with hernia, reported by Erdős. Colev had 9 cases of perineal ectopia among 126 cases of hernia associated with imperfect descent.

This variety of ectopia occurred fifteen times in 737 cases of imperfectly descended testicle observed at the Hospital for the Ruptured and Crippled from 1890 to 1907. The vast majority are unilateral. Hutchinson reported one case of bilateral perineal testis and Ammon reported another. Sorneland (32) states that of 92 cases of perineal testis many were traumatic rather than congenital in origin. This statement is rather surprising. Godard (21) reported the case of a man age 56 in whom an interstitial variety of ectopia became perineal as a result of a bandage having been worn for a long period. This case will be referred to again.

The gubernaculum is said to send a strand into the penneum, which is held to be

responsible for the testis occasionally reaching this situation. In these cases there is a lump in front of the anus to one side of the middle line. It has a restricted range of movements and rests in the superficial perineal pouch. The testis is usually of normal size and development.

It has been shown in the foregoing that in the perineal region there exists on each side two ridges of fascia which separate three pouches. The perineosrotal reduplication of Colles' fascia separates the scrotal from the superficial perineal pouch. This reduplication forms a smooth ridge. The fascia of Colles here doubles back on itself at an acute angle in the adult dependent scrotum and at a right angle in the fetal scrotum (Fig. 12). The testis or gubernaculum having traversed the third ring, passes down the scrotal neck and arrives at this ridge. At the sixth month there is a well marked scrotal pouch in the vast majority of cases. Should the fascial reduplication narrow or occlude the orifice, the testis cannot enter and may pass posterior to it into the perineum. It is not atresia of the scrotal neck as supposed by Sonneland which causes this type of ectopia, but atresia or lack of development of the actual testicular pouch. Atresia of the scrotal neck causes, as seen above, incomplete descent or interstitial or pubopenile ectopia.

In those few cases in which perineal ectopia is due to trauma applied to a partially descended or interstitial testis, the same mechanism occurs. The testis is forced down, and as the empty scrotum will be contracted, it may easily pass behind the ridge into the perineum. Where the corresponding half of the scrotum is entirely undeveloped, the descending testis must necessarily be ectopic, whether this be perineal or crural. In these cases of ectopia the cord is long and there is no difficulty in retaining the testis in the scrotum by operation.

It is agreed that crural or femoral ectopia is one of the rarest forms. There are two views in regard to its development. The testis is somewhere in the neighborhood of the saphenous opening at the root of the thigh. According to Wakely and others the condition is due to a very long mesorchium.

As the testis approaches the external ring the long mesorchium cannot exercise its customary control, so that instead of the testis being held close to the internal ring, it slips down to and prolapses through the femoral canal. It is in other words a hernia of the testis through this canal. This mode of descent is doubted by many writers. Eccles states that it is extremely doubtful if the testis has ever reached the upper part of the thigh by a spontaneous passage through the femoral canal. He further states that the classical instances of this are not very convincing. That this mechanism extremely rarely may be operative is shown by the case of Fauntleroy. This case is introduced as being the only one in surgical literature in which the testis has descended through the femoral canal and into the scrotum. So that it was not a case of ectopia finally, though it must have been so at one stage of its descent. A simpler view is that the crural testis is deflected once it gets beyond the external ring. Eccles says that the gubernacular fibers going to Scarpa's triangle are fairly constant, but are only found at a comparatively early stage of intra uterine life, disappearing usually 2 months before birth. He goes on to say that it is not clear that the gubernaculum can cause crural ectopia, inasmuch as the testis may go to Scarpa's triangle as late as commencing adult life. In this variety of displacement the cord can usually be traced through the external ring, by palpation.

It has been shown earlier in this paper that the line of the direct attachment of Scarpa's fascia to the fascia lata is variable. It may, as shown in Figure 4, cross the saphenous opening at a higher or lower level, depending usually on the degree of development of Scarpa's ligament. In those cases in which the ligament is absent Scarpa's fascia crosses the adductors and the opening rather more obliquely on its way to the ischiopubic ramus than it does in those instances in which the ligament of Scarpa holds the fascial attachment forward toward the pubic tubercle. It has also been seen that where no ligament of Scarpa exists the outer boundary of the third ring is the gutter between the direct and reflected attachment of Scarpa, and that this gutter passes

across the adductors to the fusion of Scarpa and Colles at the pubic ramus just below the situation where the falciform process of Colles is given off. The crural pouch is situated at the site of this fusion. It is of great interest to observe that the crural pouch is situated behind or internal to the inguinoscrotal fold. The most cursory examination of any male subject will show that this fold does not directly overlie and correspond to the ischio-pubic ramus, which intervenes between perineum and thigh. On the contrary, and against the general belief, this fold crosses the root of the thigh. Now as the femoral pouch is behind or medial to this fold, a testis in the pouch bears the same relation to the fold. Such a testis may bulge medial to it, or lateral to it, or push the fold forward. Thus it may easily be mistaken for a perineal testis when in reality it is crural. Only a thin fascia, namely that of Colles at its attachment to the ramus separates it from the perineum. Operative methods through the usual inguinal incision, would fail to distinguish the situation of the testis. It may be stated that unless the inner border of the organ impinges on the mid line, it is probably a crural and not a perineal testis. It would seem therefore that this abnormality may arise in one or two or possibly three ways.

1 The testis having passed the third ring lies in the neck of the scrotum suspended above three pouches the scrotal the perineal and the crural. Just as the perineoscrotal reduplication separates scrotal and perineal pouches, so the falciform process of Colles intervenes between the perineal and crural fossæ. Only the razor edge of this process separates the descending gubernaculum from the crural pouch. Now this edge is level with the bone above and rises gently to a ridge as it is followed down. The gubernacular apex is easily deflected, should it pass lateral to the edge the testis is crural.

2 When the third ring is of a wide funnel variety as happens when the ligament of Scarpa is undeveloped the testis may be hung up somewhere along the gutter bounding the ring laterally. Atresia of the lower part of the scrotal neck or a short cord may be at fault. In this way the testis may come to lie over the saphenous opening or anywhere along the

gutter, right down to the crural pouch. It is conceivable, therefore, that a testis lying in the upper part of this gutter, whether it be superficial, inguinal, or upper crural in type, may through trauma be pushed down to enter one of the three perineal pouches depending on the direction it is forced to take by the two fascial ridges. It will be remembered in Godard's case that an interstitial ectopia became perineal through the wearing of a bandage. It is more than likely that even though the testis occupied the crural pouch it would be called perineal because of its relation to the inguinoscrotal fold.

3 The writer has wondered whether a testis lying in a deep superficial inguinal fossa may not be called a crural testis, as this fossa is just above and medial to the uppermost part of the saphenous opening.

#### CONCLUSIONS

It is, therefore, apparent that once the migrating testis emerges at the external inguinal ring, it enters upon the most perilous and hazardous stage of its journey. When the obstacles to the successful performance of this transit are reviewed, the marvel is not that the organ becomes ectopic at times, but that it should so often succeed in reaching its normal destination through such a maze of devious paths.

As often as not the first barrier encountered by the scouting gubernaculum is the hog back formed by Scarpa's ligament. Here it lies in a deep valley which may cause it to travel out at right angles to its intended path. Negotiating this depression and ridge successfully, it arrives at the entrance to the scrotal tunnel, *i.e. the third inguinal ring*. Should this be absent or underdeveloped (and this may be the case with an apparently normal scrotal development as viewed from without) the gubernaculum, which is incapable of excavating, may adhere to the site where the orifice should be and remain permanently partially descended. On the other hand it may trend medially and then will either travel up or out along the fundiform ligament to a high superficial inguinal resting place. Should it, however, encounter a cave at the side of the fundiform ligament, it may adhere there, or



slip down by its own weight, nothing obstructing its progress along the penis but the length of its own central attachments

If the third ring transmitting to the scrotum is open it has not yet passed the dangers. It may come to rest somewhere in the gutter formed by Scarpa's fascia, or it may be pushed off the road by either of two additional ridges, namely, the falciform process of Colles, or the perineoscrotal reduplication. Failure to negotiate one of these obstructions will permanently prevent the testis arriving at its scrotal bed.

The author wishes to suggest that these anatomical ridges, fossæ, and orifices, some of which are present in all subjects, others of which exist in a large proportion of cases, are the most natural and likely explanation of cases of partial descent or of ectopia affecting the testis during the extra abdominal portion of its intricate transition from abdomen to scrotum.

#### SUMMARY

1 The superficial fasciæ of the groin and perineal regions have been investigated in great detail in the male subject from fetal life to old age.

2 Certain hitherto unsuspected anatomical features of great practical importance have been disclosed by the research, particularly in regard to the fasciæ of Scarpa and of Colles.

3 An undescribed layer of fascia in the perineum has been named the deep fascia of the perineum.

4 The complicated method whereby the scrotum is slung is analyzed in detail and serves to throw some light on the cause of the inequality in rate of growth of hernia.

5 Certain fascial pockets exist in the perineum and groin in a large percentage of cases. These pockets are proportionately better marked in the fetus than in the adult.

6 A third orifice is described in the inguinal region which has been named the *third inguinal ring*. This presents the form of a ring in 50 per cent of cases and the shape of a funnel in the remaining cases. It is of vast importance in connection with imperfect descent of the testis. It is easily felt clinically.

7 No evidence has been forthcoming in this research which lends the least support to

(a) the supposed "excavating" function of the gubernaculum, (b) the "traction" function of this band, and (c) the existence of the gubernacular tails of Lockwood.

8 It is shown that the spermatic cord lies as a rule  $\frac{1}{2}$  inch lateral to the pubic tubercle and not medial to it.

9 Extravasation of urine is shown to extend largely as an infiltration of the superficial fasciæ rather than as an extravasation deep to them.

10 Femoral hernia may emerge above or below the attachment of Scarpa's fascia in the groin. The size of the hernia and the direction it takes may be dependent on its relationship to this fascia.

11 The literature of imperfect extra abdominal testicular descent is reviewed.

12 A new explanation of this imperfection is put forward. It is based on anatomical findings and may fittingly be called the "anatomical explanation." Partial descent and ectopia are due to one or more of the following factors: (a) congenital anomalies or absence of the third ring, (b) congenital fascial pockets, and (c) congenital fascia ridges. It is impossible to exclude as further possible causes such factors as shortness of the mesoblastic elements of the cord or adhesions. It is, however, pointed out that such occurrences may be secondary and not primary.

13 The anatomical explanation of the various types of ectopia is entered into in considerable detail and the genesis is explained.

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CAUSES OF MORBIDITY AND MORTALITY OF OPERATION FOR GALL-STONE DISEASE<sup>1</sup>

JOHN B. DEEVER, M.D., F.A.C.S., PHILADELPHIA

THE early stage of gall bladder disease is regarded as a general metabolic disorder in which the liver plays a prominent rôle. This early stage is most often seen in young women coming to operation for symptoms of gall stone disease after a more or less recent pregnancy. The gall bladder of such a patient is usually normal in appearance, and its bile is sterile. Bile stasis within the gall bladder is another early stage of the disease. Either of the two are the forerunners of infection which, as I have constantly maintained, is no doubt due to the irritation caused by the presence of stone and the obstruction to the free flow of bile. The bacteria brought to the gall bladder from the liver or from the blood stream, fail to be carried off by the bile which remains more or less stagnant. Here then, we have the interplay of liver and gall bladder function and pathology. The effect of prolonged disease of the biliary system is furthermore seen in the phenomenon of dilatation of the right heart and myocardial weakness. The fact that there is an excess of bile in the blood without an accompanying cholesterol increase, indicates involvement of the liver cells. This is furthermore shown clinically by signs of portal engorgement which eventually must interfere with the general circulation leading to dilatation of the right heart with secondary passive congestion. If the process remains unchecked, repeated congestion causes the liver cells to lose their activity and cirrhosis dominates the picture. These facts, baldly stated as they are, furnish food for thought in connection with the morbidity and mortality of operation for gall stone disease.

The question whether the gall bladder or the liver is primarily responsible for the consequences of gall stone disease is an important one. Some investigators believe that liver involvement is, as a rule, the first step. However, this is not universally true if we are to believe the findings of workers such as A. L. Wilkie who in his experimental work on rab-

bbits clearly demonstrated cholecystitis as an entity capable of occurring independently of liver involvement. By separating the gall bladder from its liver bed and interposing a small portion of the great omentum, shutting off all lymph and blood vessel connection with the liver and injecting streptococci intravenously, Wilkie produced cholecystitis when the cystic duct was, and when it was not, ligated. On the other hand, when rabbits, without any previous operation having been done were injected, cholecystitis together with involvement of the surrounding liver substance resulted. This work with that of Rose now, Reimann, Graham, and others, proves that infection of the biliary tract takes place through the gall bladder and through the liver. Basing my conviction on the evidence of reports from the Lankenau Research Laboratory on the bacteriological and pathological study of numerous specimens, I am convinced that this is exactly what we surgeons find in autopsies *in vivo* in liver and biliary tract disease, to which I refer in this discussion.

Furthermore, it is our experience that removal of the gall bladder gives its best results where the liver is found practically, if not entirely, normal to inspection and palpation, while where the liver is more or less diseased, the ultimate results are not so good, and a certain percentage of patients fail to be relieved by operation. Removal of the chronic, interstitially diseased gall bladder, the most frequent type of the disease in the presence of a diseased liver merely breaks the chain of a vicious circle.

A matter of primary interest is the indication for operation. The difference of opinion between the internist and the surgeon in this regard, I believe, constitutes one of the main factors in the subject under discussion. It would have been interesting and valuable if time had permitted to have collected the opinions of some of our prominent internists as to how many of their patients they refer to

<sup>1</sup>Read before the College of Physicians and Surgeons, Philadelphia, March 6, 1929.

the surgeon and at what state of the disease they do so. Leaving acute cholecystitis out of consideration, I have no doubt that the consensus of opinion would be "not until conservative treatment had proved ineffectual," with out mentioning the time element. Some might qualify their statement by saying "not until the discomfort becomes unbearable." The question, however, should be considered from the social economic, as well as from the pathological standpoint.

On the whole there are few, especially among the large middle class, who can afford the more or less disability and expense that prolonged medical treatment entails. I believe that I am safe in saying that there is no difference of opinion as to the necessity of treatment including a careful regimen in these cases. I fully realize, also, the difficulty of controlling the patient's mode of living, especially among the less intelligent classes, this, no doubt, accounts for a large group of cases that fail to get well by any mode of treatment. On the other hand the cures obtained by conservative treatment are more often than not temporary, as proved by a recrudescence of the trouble. Moreover spontaneous absorption of gall stones is a pious thought fathered by the wish, and should it take place, some fragmentary concretions would inevitably remain to form the nucleus of later stone formation, so that in all likelihood the patient's later condition would be worse than his earlier one.

In the earliest stage of gall stone disease, if primary in the gall bladder—the stage of metabolic disturbance—the disease does not extend beyond the cystic duct. In other words, it attacks only the mucosa of the gall bladder and the cystic duct remains unobstructed. In these cases medical treatment, especially non-surgical biliary drainage should be promising when associated with the proper regimen, including rest and diet directed toward altering the blood chemistry. Unfortunately however the disease usually resides in the walls of the gall bladder and it is only by removing the gall bladder itself that the process can be checked and the ravages of continued infection prevented, such as cholangitis, hepatitis, hepatic abscess, pancreatitis, cardiac and renal derangement, etc. This is my answer to the

question as to the stage of the disease when the patient should be referred to the surgeon. Two, or at the utmost, three attacks of gall stone colic should settle this point.

Of course, I know that many will make the mental reservation that surgery does not always prove successful. I quite agree with you. But why does it not, in spite of good surgical technique? Here is the answer.

From the follow up observations in the Lankenau Clinic, we find that of the patients who fail to be entirely relieved within 2 years, 59.5 per cent give a history of 2 to 20 years of digestive trouble and attacks of gall stone colic, while 40.5 per cent give a history of 1 to 2 years. Let us review a few of the pathological findings at operation in some of the long-standing cases.

(2633/21) Pre operative history 12 years. Common duct obstruction by stone. Peripancreatic lymphangitis.

(3478/20) Pre operative history 12 years. Emergency operation in an acute attack. A spontaneous duodenal fistula had formed. Adhesions found involving stomach, duodenum, liver, and colon. Appendix acutely inflamed.

(916/21) Pre-operative history 5 years. Dense adhesions involving the gall bladder and the liver. Enlarged nodes along the common duct. Head of pancreas enlarged and hard. This patient was well for 13 months after operation. When seen again 1 year later (24 months after operation) she complained of pain and swelling over the site of the liver and was slightly jaundiced.

(1118/21) Pre operative history, 6 years. Neck of gall bladder adherent to common duct. Gall bladder opaque and thickened. Hepatic flexure of colon adherent to liver.

(2473/21) Pre-operative history 18 years. Cystic duct partially occluded by stricture. Many faceted stones present.

These cases were selected at random. While on the whole they are typical, I am sure that I could have found numerous other ones with more extensive affections to worry the surgeon at the operating table, to say nothing of the worries of the patient before and after operation. The only consolation the latter has is that without operation he would have been either much more miserable or else would have been transported to the bourne whence none return.

It is scarcely reasonable to expect a cure where there has been such extensive disease.

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As a not infrequent cause of postoperative morbidity, chronic pylorospasm should always be looked for and corrected. It is our practice to remove the anterior half of the pyloric sphincter, and our results have been very satisfactory. While making the Rammstedt operation is better than not doing anything, removal of the anterior half of the sphincter offers better and more permanent results.

Postoperative adhesions, although not uncommon as a cause of morbidity, do not play the rôle so often attributed to them. This can be best exemplified when an operation is done to remove stones in the common duct in the presence of extensive adhesions. In these cases better results are obtained if it is possible to remove the stone without separating the adhesions. I believe recurrence of symptoms, so often attributed to adhesions, is more often due to chronic pylorospasm. However, the adhesions should be released but the pylorus should not be overlooked.

Fistulous communication between the gall bladder and usually the duodenum, and occasionally with the hepatic flexure of the colon, may be a remote cause of morbidity. In either instance, but particularly when the communication is with the colon, infection of the liver will ultimately occur causing a symptom complex almost impossible to recognize except by sight and touch.

The most frequent causes of postoperative morbidity and mortality are some form of chronic disease of the liver, the result of a latent infection not easily recognized as such and not subjected to operation at the most opportune time when looking and acting would accomplish more than watching and waiting to see what will happen. The chronic liver is seen as either a circumscribed or a diffused fibrosis, a cholangitis, or a solitary abscess.

Circumscribed fibrosis is more common in the right lobe and more marked near the site of the gall bladder. It is manifested by white streaks on the surface, increased consistency, rounding or thinning out of its anterior border, some enlargement of the lobe especially fore and aft, and in some instances, the presence of a circumscribed boggy oedematous condition. When the left lobe enters into the picture there is usually an accompanying enlargement and

fibrosis of the spleen. Diffuse fibrosis, fortunately, is not so common a finding, but when seen comparatively early is readily recognized by the size and consistency and the thick, rounded anterior border of the liver. Occasionally a hydrohepatoptosis is seen and is usually associated with involvement of the common duct. I have known this to be so pronounced as to make the outlook seem most uncertain, but had the satisfaction of seeing it clear up after several weeks of drainage of the common duct.

A large and important aspect of our subject is common duct involvement, a complication practically always due to gall stones or their sequelæ. Stone in the common duct is rarely a primary affair. With few exceptions, biliary calculi originate in the gall bladder. When I operate for stone in the common duct I feel sorry operation was not made before the stone left the gall bladder. Involvement of the common duct, therefore, is the result of more or less prolonged gall stone disease. Such involvement may also lead to stricture of the common or of the hepatic duct or of the papilla of Vater and to regurgitation of duodenal contents (after operation) upon the duct the result of loss of function of the muscle of Oddi, due to prolonged obstruction of the duct. Stones or any other of these complications add materially to the seriousness of biliary pathology both clinically and surgically and are potent factors in the morbidity and mortality of gall bladder surgery. As far as calculous obstruction of the common duct is concerned, one simple reason for persistence of symptoms after operation is the fact that one can never be sure that all stones or traces of stone have been removed from the bile ducts at the first operation. While it is possible for stones to form in the ducts after a cholecystectomy or a choledochostomy or both, it is a safe guess that recurrent attacks of typical gall stone colic after these operations are due to stone overlooked at the primary operation.

From a surgical point of view there is perhaps no region in which accidental trauma is so easily inflicted as the common duct. Surgery upon this duct requires a clear exposure, a sharp feather edge dissection, and a bloodless field. Also the details of searching for

This is all the more to be regretted since it is, to a large extent, avoidable

From the surgical point of view the most regrettable cause of postoperative morbidity is failure to remove the diseased gall bladder or remove the gall bladder, drain the common duct, and determine the patency of the papilla of Vater, if it is not perfectly patulous it should be dilated. Contracture of the papilla of Vater by inflammatory œdema, stricture, calculus obstruction, tumor, etc., may result not only in back pressure of the bile but of the pancreatic secretion as well. Retention of pancreatic secretion in turn may cause focal necrosis of the pancreas such as occurs in a small percentage of cases of so called catarrhal jaundice that do not clear up in a comparatively short time. Therefore, change in the papilla may be one of the causes of catarrhal jaundice and of histological changes in the pancreas. Of course in acute cases, the conservative operation is rational, but in the absence of such or other contra indications, radical surgery should be the chosen procedure. There may be some patients, few and far between, however, who will not consent to having the gall bladders taken out. They have a perfect right to refuse and also are welcome to keep on being threatened with recurrent attacks of gall stone colic and all its consequences. On the other hand there are some surgeons who still adhere to the conservative method of the early days of gall bladder surgery when cholecystectomy was considered a difficult and formidable operation. They have the questionable satisfaction of contributing liberally to recurrent cases. Whether or not stones are actual recurrences or new stone formations or a stone has been overlooked, is not so important as that they occur most frequently after a cholecystostomy.

Recurrence of gall stones and persistence of symptoms after cholecystectomy is another matter. The latter, especially, can be traced directly to delayed operation. For example, while stones may be, but rarely are, secondary to cholangitis, in most instances the reverse is true, in that prolonged calculous infection leads to a cholangitis, which as we all know, is stubborn, troublesome, and dangerous requiring prolonged surgical drainage and a

strict dietary and hygienic regimen. I have drained the common duct as many as three different times in one patient. Each time I removed many minute stones mixed in with muddy, dirty looking bile. At the last two operations after clearing the hepatic duct and its primary branches with a scoop, I irrigated the duct. Since the last operation, 5 years ago, the patient has remained perfectly well.

It must be remembered, also, that gall stone disease oftentimes affects surrounding organs besides the liver, causing a chronic pyloro spasm, peptic ulcer, pancreatitis, as well as cardiorenal derangement. Indeed, gastroduodenal involvement is very frequently associated with gall stone disease demanding still further surgery, mainly gastro enterostomy. More serious, because less amenable to treatment, is pancreatitis, either as a primary surgical complication or as a postoperative phenomenon. If at the primary operation the peripancreatic glands and the head of the pancreas are found affected, persistence or recurrence of symptoms is to be expected although a prolonged and careful postoperative regimen may prevent serious trouble.

The presence of such changes makes a complete cure doubtful. It also raises the question of radical versus conservative surgery, the answer to which will depend, to a great extent, on the degree of pathology. Marked hepatitis, and marked cholangitis as well as marked pancreatitis may be handled by making either a cholecystoduodenostomy or a cholecystogastrostomy after the stones, if present, have been removed from the gall bladder, however, common duct drainage with a T tube is the better procedure. In passing I would say that in neither of the anastomosis operations does the new stoma remain permanently patulous, except in the presence of complete occlusion of the common duct. Furthermore, the cholecystoduodenal anastomosis is a delicate operation and in the hands of the less experienced surgeon presents the danger of a subsequent duodenal fistula, so that the gastric anastomosis is the safer of the two procedures. On the other hand as long as the gall bladder remains *in situ*, reformation of stones is likely to occur even where the gall bladder has been anastomosed.

In some cases of calculous obstruction of the common duct associated with marked jaundice as well as in certain cases of cholangitis and hepatitis, a cause of mortality is failure to make a preliminary cholecystostomy for the purpose of decompressing the liver. In addition to this preliminary drainage, diathermy to which I have referred, is a most valuable adjunct. Decompression by simple gall bladder drainage is likewise applicable to bad risks such as certain cases of chronic pancreatitis and carcinoma. If improvement follows this procedure and the patient's condition warrants, further surgery may be done. An anastomosis operation may often be successful, although the easiest way out is not by any means always the best, yet it has its indications.

As I have said, the effects of obesity add materially to the surgical risk. As most gall-bladder patients are not emergency cases, some surgeons advise a rapid reduction of weight immediately before operation. This is a questionable procedure inasmuch as it also reduces the patient's power of resistance. If loss of weight is desirable, it should be done slowly by suitable diet and exercise, depending, of course, upon the general health of the patient and the severity of the gall bladder symptoms. It is in the obese, stocky patient, also, that pulmonary embolism is most likely to occur, although there is no way whatever of foretelling or forestalling this hapless and usually hopeless catastrophe which we all dread and deplore. Coronary thrombosis on the other hand, is a condition that may have manifested itself before operation. While this complication constitutes an unpleasant surgical risk, spinal anesthesia has brought many of such patients within the operable class, but they require special pre-operative and post-operative care to prevent an attack. Some times, however, in spite of all precautions a sudden seizure carries the patient off and surgery bears the blame, unjustly, of course. If in these cases, the gall stone disease was of long standing the inference is plain.

Hæmorrhage, in our experience, rarely occurs except in the presence of severe jaundice and even then only seldom owing to the advances made in pre-operative and post-

operative care by the intravenous administration of calcium chloride, and blood transfusion in addition to X ray of the spleen before operation to lessen the clotting time. This is one of the greatest steps forward in gall stone surgery that has occurred in recent years. An occasional case of carcinoma that has been jaundiced for several weeks will succumb to bleeding after operation, do what you will. This only argues in favor of more prompt interference in jaundiced patients that do not yield to treatment in a week or 10 days. Oftentimes the reason for deferring operation is the uncertainty of the diagnosis. This, I believe, constitutes one of the strongest indications for opening the abdomen. Primary and consecutive bleeding should not occur if the operation is properly made and secondary hæmorrhage should be rare except in the severely infected cases, and these are not frequent.

Primary and consecutive bleeding are the result of not exposing and tying the cystic artery or its two branches under the guidance of the eye, the *sine qua non* of a successful operation. Another cause of bleeding is failure to close the gall bladder bed completely by suture where it has not been possible to do a subserous cholecystectomy, although by careful dissection this can nearly always be done. In closing the gall bladder bed all small bleeding vessels should be ligatured before the bed suture is introduced. Packing the gall bladder bed to arrest either primary or secondary bleeding is obsolete, and is only very exceptionally indicated. Here, as elsewhere, knowledge of the anatomical relations of the parts exposed is absolutely essential in order to avoid mistakes. Where bleeding occurs soon after the primary operation, the only rational course, with few if any exceptions, is to open the wound and secure the bleeding point or points. Secondary bleeding, the result of an ulcerated process, is a different proposition. Here, thorough packing carried to the extreme depth of the wound is the correct procedure. Blood transfusion may be necessary but will not take the place of good surgery, nor is it to be given injudiciously. I have seen serious consequences from blood transfusion, such



stone in the common duct are delicate to the extreme and the effects on the body of manipulations in this region, as pointed out by Crile, are comparable to the effects of manipulation on the spinal cord or the brain. Then, also, there is the effect on the liver function caused by draining the common duct, and the sudden decompression of bile in a jaundiced or recently jaundiced patient. The toxic effect of jaundice on the entire system needs no discussion. We all know that it means a tendency to bleed, as well as hepatic and renal insufficiency. Again, I am obliged to say that this complication is to a large degree avoidable by early attention to cholecystitis and its associated phenomena.

Not all cases of postoperative morbidity in biliary tract disease, however, are due to actual recurrences. Neurosis contributes largely to this class of cases. Although imaginary ills to the complainant hurt as much as real ones, they are neither so easily nor so successfully treated. There are, no doubt, many people who enjoy poor health. What to do with such I gladly leave to the neurologist, the psychiatrist and the psychoanalyst.

Now as to the surgical mortality of gall stone disease.

In the Lankenau Clinic, the most common cause of death is cardiovascular disease—acute dilatation, embolism, and coronary thrombosis. Whether or not acute dilatation is an entity is questioned by some of our able internists. We know it occurs, but these opinions to the contrary notwithstanding. Most cardiac deaths occur in heavy, obese women in whom, doubtless, the deposit of fat about the heart acts as an additional factor in a heart that, in most instances, is already attacked by myocardial weakness. In these cases we derive very little satisfaction from digitalis, in our experience, small doses of morphine given at regular intervals are much more effective. Do what you can, and say what you please, these obese patients increase the weight of our responsibility.

Pneumonia stands very low in the list of causes of postoperative deaths. This is, at least, partly due to operating under intra spinal anesthesia which enables the surgeon to work rapidly and with greater ease, which

in turn, of course, means less risk to the patient, diathermy also is a great factor in reducing the incidence of postoperative pneumonia.

So called liver shock, spoken of by many writers, we rarely if ever, see. We agree with Crile that shock is due to faulty pre-operative care and failure to use diathermy during the operation. Diathermy is our stand by in all serious abdominal operations. As remarked by Miss Rapp, our chief anesthetist for many years:

"Doctor, your diathermy patients are not sweaty and depressed as they were before we used this means of maintaining as well as increasing, the bodily temperature."

Maintaining the temperature of the liver and the bodily temperature in heavy abdominal operations is most important and can be best obtained by the application of diathermy not only during the operation but, in some instances, for some hours after operation. We have found it very advantageous, for example in chronic cholangitis of some standing with profound jaundice, after a drainage operation to apply diathermy constantly for 2 to 3 hours daily. There is no other organ whose depressed function so affects the entire system as that of the liver. It is, therefore, essential to take advantage of such liver functional tests as are at our disposal, and to bring liver function as near to the normal as possible before operation and to avoid depression during the operation by the use of intraspinal anesthesia and the keeping of the entire field warm by the use of diathermy effectually and hot gauze pads within the abdomen. The systemic effects of hepatic disease or surgical trauma are sufficiently explained by the nerve supply of the liver. Lying as it does, within the center of the sympathetic system with its network of nerves and ganglia close to the celiac plexus, this intricate plexus is necessarily affected by anything that affects this intra abdominal area, including of course, the gall bladder whether by a disease process or operative trauma, or postoperative contact with drainage or adhesions. If as Crile well says, the celiac plexus is the abdominal brain, then the liver can be called the abdominal medulla.

true that the phenoltetrachlorophthalein test claims to meet the requirements of accuracy, simplicity, and safety, but its safety is questioned, inasmuch as a deleterious effect on the liver cells has been observed. On the other hand, such an eminent authority as Rowntree finds it a perfectly safe procedure. As I have said, the matter is not as yet definitely settled. Co-operation of the laboratory re-

search workers with the surgeon will finally provide the answer, I feel sure.

On the whole, it may be said that there are still too many patients who come to surgery as a last resort. Improvement in morbidity and mortality of operation for gall stone disease will go hand in hand with early diagnosis and early surgical treatment where reasonable medical measures have failed.

as a blood clot carried along causing thrombosis, embolism and death

So called bile peritonitis occasionally listed as a cause of death, I believe, in most instances, is not peritonitis at all but intra peritoneal leakage of bile. Whenever I have had the opportunity to operate in such conditions where a large amount of bile is drained, the smears were negative. A peritonitis with bile in the peritoneal cavity, may result from bacteria having passed through the intestinal walls. Early evacuation of the bile will solve the riddle.

In this connection, I would call attention to some recent work of Ravdin, Morrison, and Smythe at the Laboratory of Research Surgery of the University of Pennsylvania. They make a distinction between bile peritonitis and bilious ascites transudations or extravasations. In the former the patient presents a picture of a diffuse or diffusing peritonitis, while in the latter there may be a large accumulation of bile stained fluid which is apparently innocuous. They have confirmed the work of other investigators, that sterile, as well as infected bile, may cause bile peritonitis. Of course it is possible that the bile, especially if enough of it is present, causes denudation of the serosal surfaces and thus permits of secondary infection.

In bilious ascitic accumulations, the toxic factor of the bile is either not present or only a very small amount is present. Ravdin and his co workers believe that in these cases the fluid is a transudate from the portal system, as a result of portal stasis associated with obstruction of the common duct.

A unique case of bile ascites occurred in my experience some time ago. The patient, a hard working preacher, was sent to me with the diagnosis of abdominal carcinoma and ascites with jaundice. I concurred in the diagnosis, but when the abdomen was opened there was found a large amount of bile stained ascitic fluid, a very much enlarged gall bladder and common duct with enlargement of the liver, which was normal in consistency, but a little darker than normal, due to back pressure of bile, fibrosis of the head of the pancreas, enlargement of the peripancreatic glands and, on opening the common duct,

occlusion of the papilla of Vater. No evidence of stone or malignancy was present. Continuous drainage of the common duct for a number of weeks and dilatation of the papilla of Vater resulted in complete recovery, and the patient has remained well. In passing, I may say in my experience, such cases are rare.

Infection is a cause of mortality in a small percentage of cases, especially if the streptococcus and colon bacillus are the predominant organisms. I am glad to say we do not meet with this as often as formerly, partly due, I think, to the introduction of cholecystography. Cholecystographic study, in fact, is largely responsible for earlier recognition of gall stone disease by the internist who usually sees the patient first. I am operating upon more early cases than before Graham's epoch making discovery which, no doubt, has lessened the responsibility of the internist and of the surgeon as well. The surgeon, however, still has to make too many decompressions of the liver in jaundiced patients largely due to delay in advising surgery.

Much has been written upon the relationship between late gall stone disease and the toxic heart. Granting the views expressed in these discussions to be correct, which I believe they are, the toxic heart then becomes a sequel of delay and fatality caused by such a diseased heart should not be shouldered upon the surgeon.

That hepatic insufficiency plays a rôle in the mortality following operation for gall stone disease is evidenced by the reports of various surgeons on this important subject. We furthermore know that hepatic insufficiency is the forerunner of renal insufficiency. This explains why formerly many deaths from hepatic insufficiency were labeled as due to uræmia.

The question, naturally, is related to liver function, the study of which is still in its infancy although progress in the right direction is being made. It goes without saying that a safe and practical test for liver function, such as we have for renal function, would go a great way toward reducing the deaths from hepatic insufficiency, for the results of such tests would decide the question of operation. It

difficulty in classification. There is good reason to believe that the term is a misnomer, a view firmly held by Cheate of England who believes that the predominant feature of the condition, the hyperplasia of the epithelial element sometimes to the extent of two or three layers, does not mean a preceding inflammation as the term mastitis would indicate.

In the older writings on diseases of the breast there was frequent mention of "hydatid" and "echinococcus" cysts. Abernathy, Bill, and Copper supposed all cysts of the breast to be hydatid. Later, writers such as Brodie, Paget, and Virchow believed the cysts were formed because of obstruction of the ducts and called them retention cysts. Sir Benjamin Brodie first described the gross pathology and clinical findings in the condition now called chronic cystic mastitis or abnormal involution. At that time it went under no less than 23 different names, probably because of the three prevalent theories of etiology: inflammatory disturbance, neoplasia, and perversion of involution. Inflammatory signs such as pain, tenderness, transitory swelling, serous, milky, purulent or bloody discharge from the nipple, induration, cysts, lymphocytic infiltration and disturbance of the stroma, all pointed to an inflammatory basis of etiology, although apparently the normal breast itself may show signs suggestive of chronic inflammation. (The writers have been unable to find adequate microscopic studies of normal breast tissue at various ages in single, lactating and parous women.)

The epithelial hyperplasia, degenerative tendencies, and the finding by some of carcinoma in as many as 15 per cent of cases led others to believe the condition neoplastic. (This figure is confusing for in practically every case of breast carcinoma chronic mastitis may be found in some form or other. Similarly the picture of chronic mastitis may be seen associated with other tumors especially the fibro adenoma and papillary cystadenoma. Of 433 cases of breast tumor treated at this clinic, chronic mastitis was found alone or associated with another tumor in 90 per cent.) Blood good, however, thinks it too diffuse a process to be precancerous. The perversion of involution theory has found favor with some

Warren called it abnormal involution in describing the proliferation of acini with papillary outgrowths of epithelium into cysts, this adenomatous proliferation fusing to make a solid mass of cells. He found the latter in 15 of 517 cases of carcinoma with accompanying chronic cystic mastitis (Papillary cystadenoma is apparently an advanced stage of this process.) The chief macroscopic lesion is the cyst, often in the small "blueberry" form, the chief microscopic lesion the proliferation of epithelium.

One point which must be kept in mind in the classification is the possibility of two fairly distinct processes existing in one tumor. A growth predominantly intracanalicular may show areas of adenomatous overgrowth and acinous dilatation that suggest a fibrocystadenoma. If the epithelium in these tissues shows one or more layers of hyperplasia, it is impossible to say that this is not an early chronic cystic mastitis. Whether the tumor described as fibrocystadenoma is a distinct entity or simply an early or late phase in the process of chronic cystic mastitis is one of the debatable questions. Its occurrence chiefly in younger women points to the former, but the presence of so much fibrous tissue and the frequent macroscopic cysts suggest the latter. Round cell infiltration is of little aid in this situation, because a large percentage of all the tumors in the series which follows showed this to greater or less degree.

Although Warren's general classification of benign breast tumors into periductal fibroma, fibrocystadenoma, papillary cystadenoma, and abnormal involution probably covers these tumors most broadly and accurately, in the following analysis the term chronic cystic mastitis is substituted for abnormal involution on the ground that the former is more commonly used. In his recent paper on benign breast tumor classification McFarland states that he found over half of a series of 289 cases studied by him to show no tumor microscopically although the patients had all complained of a lump in the breast. In the present series this was found to be true when the strict pathological definition of tumor was applied. However, since all the lumps showed definite pathological changes and since the borderline

## BENIGN TUMORS OF THE FEMALE BREAST

A CLINICAL AND PATHOLOGICAL STUDY OF 201 CASES TREATED BETWEEN 1875 AND 1913  
AT THE CLINIC OF THE FREE HOSPITAL FOR WOMEN, BROOKLINE, MASSACHUSETTS

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THE object of this analysis is to determine the results of operation for benign breast tumors, the percentage and character of recurrences, the frequency of bilateral involvement, the incidence of malignancy and the type of benign change with which malignancy is most likely to be associated. Since difficulty in arriving at a definite diagnosis in some cases was experienced early in the work, emphasis has been placed on the classification. This difficulty is by no means new, since from the first attempt at systematic classification in 1905 by J. Collins Warren, there has grown up a varied and confusing terminology.

Before the middle of the nineteenth century all tumors of the breast were regarded as carcinoma. When Cruveilhier first recognized the existence of benign tumors of the breast, a storm of opposition was raised in the French Academy of Medicine. Cruveilhier described a fibroma, but this name was not accepted and a multitude of terms was used. Johannes Mueller named it *cysto sarcoma phylloides*, Brodie called it *serocystic sarcoma*, Astley Cooper, *hydatid tumor*, Billroth, *fibroma* and *cystosarcoma*, Paget, *chronic mammary* and *proliferous cysts*. The diversity of nomenclature seems to have been due to the attempt to reduce the tumor to its component parts descriptively, i.e., to indicate in its terminology whether the stromal or epithelial elements predominated. Ribbert reached the most satisfactory solution of the difficulty by grouping the tumors, not as *fibroma* or *adenoma*, but as *fibro epithelial growth*.

*Periductal fibroma*. There is a certain class of benign tumor which offers a fairly consistent picture under the microscope. This was called by Warren, as well as by others later, the *periductal fibroma*, with *myxomatous* and *sarcomatous* variations. It is commonly known as the *intracanalicular adenofibroma*. Greenough and Simmons have described it as a passive distortion of the epi-

thelial elements of the gland by the growth of the connective tissue stroma, mainly the periductal tissue. When the ducts and acini are flattened to mere slits, by the stromal overgrowth, it is called *intracanalicular adenofibroma*.

*Fibrocystadenoma* or *fibro-adenoma*. The type of tumor closely related to the preceding one was called by Warren *fibrocystadenoma* and, in a recent classification by McFarland, *fibro adenoma*. Horsley believes that this growth is always cystic, very often only microscopically, in the form of dilated acini. In this tumor the pathology suggests that the epithelial elements have become irritated or stimulated by a pre-existing stromatous hyperplasia. There is uncertainty of diagnosis in the minds of many, for several published series of benign breast tumors show striking differences in the incidence of this tumor. Warren gave the proportion as 1 per cent, Horsley as 35 per cent, and Greenough and Simmons as 25 per cent. It is difficult to differentiate this tumor from the condition known as *chronic cystic mastitis* or from *abnormal involution* especially when the cysts in these processes are small, when there is little evidence of inflammation and when they occur in young women.

*Papillary cystadenoma*. The growth known as *papillary cystadenoma* stands out fairly definitely with its cyst formation and proliferation of the epithelial lining into papillae. It has long been looked upon with suspicion because of the occasional occurrence of bloody discharge from the nipple and the excessive hyperplasia of epithelial cells. Warren and Greenough and Simmons in 1907 studied 20 cases and found carcinoma associated in 15 per cent. In contrast to this, Hart in 1927 reviewed 124 cases and found no tendency toward malignancy in the 66 cases which he was able to trace from 10 to 30 years.

*Chronic cystic mastitis*. Lastly, the condition commonly called *chronic cystic mastitis* offers

The duration of the complaint varied from a few days to 20 years. The average duration is divided among the groups as follows: periductal fibroma,  $2\frac{1}{2}$  years, fibrocystadenoma 1 year, papillary cystadenoma,  $2\frac{1}{2}$  years, chronic cystic mastitis, 1 year and 9 months. A striking difference in duration before coming for treatment was noted between the private patients and those treated in the Free Hospital. In the former group it was a matter of a few weeks, often days, with 2 or 3 of longer duration bringing the average up to 5 months as compared with 1 to 2 years in the latter group.

#### OPERATION, PATHOLOGY, AND RESULTS

The surgical procedures were simple resection of the breast, subcutaneous amputation of the breast, simple amputation and radical amputation which included dissection of the axilla.

*Periductal fibroma.* In this group (57 cases) the primary operations were resection of one breast, 43; resection of both breasts, 2; subcutaneous amputation of one breast, 1; simple amputation of one breast, 5; radical amputation of one breast, 5; resection of one breast and simple amputation of the other, 1.

The typical periductal fibroma was the only pathological finding in 22 cases. Chronic mastitis was found associated with it in 28 cases. Unmistakable sarcoma was present in 4 cases, probable sarcoma in 3 (in these the tumors were more active than usually found, but could not be called frank sarcomata, they rank in the same category with some of the low malignancy leiomyosarcomata of the uterus).

One of the 4 patients with definite sarcoma died of pulmonary embolism 5 days after operation. She was 35 years old. The second, who had had primary resection of the breast and simple amputation 2 years later for recurrence at another hospital, had the pectoral muscles removed and the axilla cleaned out at this hospital 3 years after the first operation and is now untraceable. The third patient died of recurrence  $1\frac{1}{2}$  months after radical operation. The last patient died  $5\frac{1}{2}$  years after her first operation, a simple amputation, having had in all 27 operations for

recurrences. Two of the probable sarcoma cases are untraceable, the third was well 11 years after radical operation.

Of the remaining 50 cases in this group 13 are untraceable. One patient died of melanotic sarcoma (from a pigmented mole of right axilla) 1 year, 4 months after operation, having had no further breast trouble. Twenty-nine patients were well at the time of follow-up. They are tabulated as follows: well 6 months to 1 year later, 3; well 1 to 2 years later, 5; well 2 to 3 years later, 2; well 3 to 5 years later, 6; well 5 to 10 years later, 4; well 10 to 15 years later, 9.

Seven periductal cases (21.2 per cent of those traceable more than 1 year) had further breast trouble. Of the 6 tumors recurrent in the same breast 5 were periductal fibromata and one a chronic cystic mastitis. Five of these 7 also had tumors of the opposite breast removed (periductal fibroma, 2; fibroadenoma, 1; chronic cystic mastitis, 1, unknown, 1). Bilateral recurrent nodules were present in 1 case 10 years after the second bilateral resection. The other patients were well 3 to 20 years later.

In 5 patients the tumor was bilateral at the time of operation or became so later. Six of the 7 patients who had children after operation experienced no difficulty in nursing, from the breast operated upon. The seventh had no milk in the breast operated upon, recurrent tumor being present. Another patient had a normal pregnancy and labor after both breasts had been amputated. Although she was unable to nurse, she stated that a few nodules formed in the amputation scars following delivery.

*Fibro adenoma.* Of 16 cases in this group 14 had unilateral resections, one unilateral subcutaneous amputation, and one unilateral radical amputation. Fibro adenoma was the only pathological finding in 8 cases, it was associated with chronic cystic mastitis in the other 8.

Four of this group are untraceable. Eight patients were well and had had no further breast trouble 3, 6, 6, 8, 10, 10, 11, and 11 years after operation respectively. Four patients (33.3 per cent of those traceable) with later trouble are briefly summarized

between abnormal breast changes and neoplasia cannot be defined it seemed proper to regard all the lumps as tumors.

The following series comprises 201 cases of benign breast tumor of which 38 were private patients of Drs. William P. Graves and Frank A. Pemberton. Table I shows the number of cases according to the above classification.

TABLE I—CLASSIFICATION

Tumor	Number of cases	Percentage of total
Periductal fibroma	57	28.3
Fibrocystadenoma	16	7.9
Papillary cystadenoma	14	6.9
Chronic cystic mastitis	114	56.7

(During the period covered by this series 234 cases of malignant breast tumors 2 per cent of which were sarcomas were treated at this clinic. This makes the proportion of malignant to benign tumors 19 to 1. During this same period four cases of tuberculous mastitis were treated by operation. They comprise 2 per cent of the benign tumors and 0.9 per cent of all the breast tumors. One of these died of pulmonary tuberculosis 2½ years after operation. The other three were well 1 year, 1 year and 7 months and 13 years after operation respectively.)

## HISTORY

**Family.** There was a family history of breast carcinoma in 6.1 per cent of the series, of malignant disease in 14 per cent, of tuberculosis in 13.4 per cent.

**Past history.** Sixty-one patients had had 97 operations of which 69 were pelvic. Two patients had had previous incision and drainage of breast abscesses. Those who had had previous removal of a breast tumor will be considered under recurrence.

**Marital history.** In the group with periductal fibroma 26 patients were single, 45.6 per cent. Six married patients had never been pregnant, 19.3 per cent. The average number of children per married patient was 1.9, of pregnancies, 2.5. In the fibroadenoma group 8, 50 per cent, were single. The average number of children per married patient was 1.2, of pregnancies, 1.7. In the papillary cystadenoma group 14.2 per cent were single and 25 per cent of the married patients had never been pregnant. The average number of pregnancies per married patient was 3.1. Forty, 35 per cent, of the patients with chronic cystic mastitis were single. Seventeen of the married patients had never been pregnant, a sterility percentage of 23.6. The average number of pregnancies per married patient was 2.2, of children 1.7.

Table II shows the ages of onset of symptoms in the four groups.

TABLE II—AGE INCIDENCE

	Periductal fibroma	Fibrocystadenoma	Papillary cystadenoma	Chronic cystic mastitis
Under 20	13			
20 to 25	13	3	3	4
25 to 30	7	7		10
30 to 35	4	6	1	14
35 to 40	13		2	33
40 to 45	2		4	16
45 to 50	3		1	22
Over 50	2		3	15

TABLE III—MENSTRUATION—PERCENTAGE

	Passed through menopause before onset of symptoms	Dysmenorrhea	Menorrhagia	Metrorrhagia
Periductal fibroma	3.8	32.6	3.8	13.4
Fibroadenoma	0	37.5	0	28.5
Papillary cystadenoma	37.5	37.5	0	0
Chronic cystic mastitis	23.5	13.4	0	8.9

In those with chronic cystic mastitis the onset of breast symptoms seemed to be associated with the menopause in 20 patients, 5 of whom had had operative menopauses. Of the whole series 18 per cent were in the subinvolution or involution phase of reproductive life and 42.3 per cent of those who menstruated had some abnormality of menses.

TABLE IV—SYMPTOMS—PERCENTAGE

	Periductal fibroma	Fibrocystadenoma	Papillary cystadenoma	Chronic cystic mastitis
Lump	57.8	56.2	35.7	57
Tender lump	24.5	12.5	35.7	18.4
Lump tender or larger before catamenia	14	31.2	14.2	7.09
Lump and discharge from nipple	0	0	14.2	7.09
Discharge from nipple	0	0	0	1.7
Lump, varying in size	1.7	0	0	5.1
Trauma followed by lump	3.5	0	0	1.7

Lump appearing during and disappearing after pregnancy, 0.8 per cent. Six patients had never noticed a lump in the breast operation being performed coincidentally with that for a pelvic condition after discovery of the mass during routine physical examination. Seven had the opposite breast involved without knowing it. Of the 48 patients with pain in the tumor 6 stated that it began some months before the mass was noted, 6 mentioned it as beginning after the mass was felt.

later pregnancies and found no difficulty in nursing from the operated breasts

#### SUMMARY AND CONCLUSIONS

1 Benign breast tumors are discussed and a resume of 201 cases is given

2 Fifty five per cent of the series had never nursed. It is not known how many of those who had children did not nurse

3 The majority of the periductal fibroma cases were under 30 years of age when symptoms were noticed. All of the fibro adenoma cases were under 35. Most of the papillary cystadenoma and chronic cystic mastitis patients were over 35

4 Abnormality of menstruation was complained of by 42.3 per cent of those who had not passed the menopause. Eighteen per cent of the series were near, at, or had passed the menopause when symptoms began

5 Changes in the affected breast or breasts associated with menstruation were noted by 13.7 per cent

6 Discharge from the nipple was complained of by 14.2 per cent of the papillary cystadenoma cases and 8.8 per cent of the chronic mastitis cases

7 The duration of symptoms bore no relation to the extent or seriousness of the lesion

8 Sarcoma was found at the primary operation in 7 per cent of the periductal cases. Carcinoma was present in 28.5 per cent of the papillary cystadenoma group and in 1.7 per cent of the chronic mastitis cases. Thus ten 4.9 per cent of the whole series had associated malignant breast disease at the primary operation. Three patients (one of the fibro adenoma class and two of the mastitis group) had breast carcinoma at a later date. These make 1.9 per cent of the traceable cases

9 Bilateral involvement occurred in 1.3 per cent of the periductal cases and in 35.2 per cent of the chronic cystic mastitis cases

10 Later benign breast disease occurred as follows: periductal (21 per cent of the whole group had had one breast amputated at the first operation), 21.2 per cent, fibro adenoma (12.5 per cent had had one breast amputated),

25 per cent, papillary cystadenoma (64.2 per cent had had one breast amputated), 10 per cent, chronic cystic mastitis (36.8 per cent of the group had had one breast amputated at the first operation), 27.7 per cent. Possibly the high percentages of recurrence are accounted for by insufficient removal of tissue at the primary operation

11 The difference between normal and pathological breast tissue is extremely difficult to define even when a lump is present grossly. Probably many pathological breasts are unnoticed or neglected (for example abnormal tenderness or a diffuse chronic mastitis with slight induration) until a lump appears. This will be benign in 49 instances and malignant in 51, depending on the presence or absence of the unknown biological factors that are associated in cancer production

12 The benign breast tumors have a close pathological relationship to each other. Furthermore, not only are they associated with the whole cycle of ovarian and reproductive life, but more especially with lack of normal breast function and with involution—factors which result in stasis and lack of drainage

The writers wish to express their gratitude to Drs William P. Graves and Frank A. Pemberton for the use of their records and for their valuable assistance. They also wish to thank Dr E. D. MacMahon for his help in working up the pathology

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1 Symptomless lump in scar and a lump in opposite breast, which increased in size and became tender before menstruation, 1 year and 5 months after a subcutaneous amputation

2 Small lump in same breast, which enlarges and becomes sore before catamena, 2 years and 9 months after operation

3 Lump and inflammation in same breast following trauma 13 years, 4 months after resection

4 Radical amputation of opposite breast for carcinoma 20 years after a simple resection Well 1 year later

One patient nursed three infants without difficulty following unilateral resection

*Papillary cystadenoma* Of 14 patients in this group, 5 had resections, one a simple amputation and 8 radical amputations, all unilateral Papillary cystadenoma and chronic mastitis were found together in 10 cases. In the other 4, 28.5 per cent, carcinoma was also present

One of the carcinoma patients is untraceable, one was alive with a recurrence 1 year after operation. The third had a recurrence excised 7 years after operation and was well 5½ years later. The fourth had a recurrence excised 8 years, 8 months later and was well 20 years after the first operation

Of those cases without carcinoma, 3 are untraceable. One patient died of cerebral hemorrhage 5½ years after operation, having had no later breast disturbance. Five patients were well 1 to 10 years later. Amputation of the opposite breast for chronic cystic mastitis was performed on one patient 3 months after primary operation and she was well 1 year, 3 months later

*Chronic cystic mastitis* 114 cases In this group there were 58 unilateral resections, 9 bilateral, 10 subcutaneous amputations, 1 bilateral, 21 simple amputations, 4 bilateral, and 6 radical amputations, resection of one breast and amputation of the other, 1, resection of one, subcutaneous amputation of the other, 2, resection of one, radical amputation of the other, 2

In 4 cases one or two small areas of the periductal type of growth were found. All the others showed chronic cystic mastitis and 2

of these showed also carcinoma and chronic mastitis in the opposite breast which was removed radically at the same operation

Twenty six patients are untraceable. One of the remainder died of recurrent carcinoma of the breast 1 year after operation. The following 62 had no further breast trouble: 1 to 2 years after operation, 12; 2 to 3 years after operation, 7; 3 to 5 years after operation, 11; 5 to 10 years after operation, 11; 10 to 15 years after operation, 15; 15 to 20 years after operation, 6

Fourteen patients had subsequent operations on the same or both breasts for chronic mastitis 1 to 20 years after the primary conservative operation. One died of carcinoma of the stomach 4 years after the second operation, another died of pulmonary tuberculosis 11 years after her third breast operation. One patient complained of pain and lumps in her breasts 10 years after her second bilateral resection. Six, with later follow up, were well 3 to 19 years after the last operation

Two patients had a lump in the same breast 1 and 5 years after operation, but did not undergo another operation

One patient complained of a lump in the opposite breast and had operation on the opposite breast for mastitis 2 months to 10 years after their first operation. Four of these were well 2 to 10 years after the second operation

Two patients had carcinoma of the breast at a later date. One of these had resection of the left breast for chronic cystic mastitis 6 years after resection of the right breast for the same trouble. Bilateral simple amputation 15 years after the second operation revealed carcinoma in the left breast. She is now well 5 years after the removal of the carcinoma. The other had a radical operation on the right breast for carcinoma 3 years 5 months after a bilateral resection and died of recurrence 6 months later. (It is not improbable that this patient had carcinoma at the primary operation but the disease could not be found in the excised specimen)

In 31 cases the process was bilateral at the primary operation or became so later. This makes the percentage for bilateral involvement at least 27.1. (Some untraceable cases probably had recurrences.) Two patients had

orrhage and without obstetrical intervention, in spite of the presence of a large sessile fibromyoma of the fundus of the uterus. The tumor weighed 5 kilograms when removed by hysterectomy 6 weeks after delivery.

A large fibromyoma of the posterior uterine wall, lying in the pelvis, may recede out of the pelvis, during labor, permitting delivery. This happened in case reported by Homans—the tumor weighed 2½ pounds and was 6 inches in diameter when removed a few weeks later.

Tumors which deform the uterus greatly increase the incidence of abnormal presentations and positions of the fetus. Normally 95 per cent of presentations are vertex, but in a fibromyomatous uterus, only 54 per cent of the presentations are vertex, 24 per cent are breech, and 19 per cent transverse (Noble). In vertex presentations, fibroid tumors may cause occipitoposterior positions and, in these positions, injuries to the child during delivery occur five times more frequently than in occipito anterior positions (Kerr).

A fibromyoma of the lower uterine segment or of the cervix may displace the cervix and offer serious obstruction to labor. When there is such obstruction, delivery by version or with forceps may injure the child, rupture the uterus or bruise the tumor. The damaged tumor may then undergo degeneration or become infected and gangrenous.

Submucous fibroids apart from pregnancy are often extruded through the cervix. They may prolapse during pregnancy labor, or the puerperium and may even invert the uterus.

Fibromyomata may cause placenta prævia. Low implantation of the placenta has been found present in 35 of 53 cases investigated at the Baudelocque Clinic in which there was co existence of fibromyoma and pregnancy. This low implantation not infrequently leads to hæmorrhage from partial separation of the placenta (Mialimiak). Severe postpartum hæmorrhage may occur when the placenta has been implanted over a tumor. Retention of the placenta and membranes in whole or in part after delivery of the child, may result from adhesions to a fibroid or from obstruction of the birth canal by a tumor.

By lessening the effectiveness of the uterine musculature, fibromyomata may cause

inertia. They rarely, if ever, cause spontaneous rupture of the uterus during labor. They may delay involution after delivery, especially when the uterus becomes retroverted.

Fibroid tumors may cause the death of a fetus by direct compression, or by lessening its nutrition through the placenta. The fetal mortality in pregnancies complicated by fibroids is high, because of the frequent occurrence of abortion and premature labor, the prematurity of the fetus in cæsarean operations undertaken before full term, and the accidents connected with obstetrical maneuvers during delivery.

Fetal malformations have been found in cases in which pregnancy was complicated by fibromyoma (Voron, Harris, Case 3). In most cases, it is probable that the fetal malformations will not be found to be directly caused by the presence of the uterine tumors.

Fibromyomata of the uterus may produce pressure upon the colon during pregnancy, leading to fecal stasis and toxæmia. The tumors, by pressure upon the bladder and ureters, may cause urinary stasis, a condition often complicated by cystitis and pyelonephritis. According to Hartmann and Bonnet urinary retention is more often caused by fibromyomata of the posterior surface of the cervix or of the retroverted body of the uterus, than by those tumors of the anterior wall which are in direct relation with the bladder.

The diagnosis of fibromyoma and of pregnancy, separately or combined, at times offers great difficulty. Ease of diagnosis of fibromyoma depends upon appreciable size and accessible position of the tumors and irregularity of the uterus. Pyosalpinx and ovarian or parovarian cysts are at times difficult to distinguish from tumors of the uterus. Early pregnancy in a large fibroid uterus may easily escape recognition. A dead fetus may be mistaken for a degenerating interstitial fibromyoma, and in several recorded cases a fibromyomatous uterus has closely simulated a pregnant uterus (Spencer, Bevan, Hartmann, Colella).

When pregnancy occurs in a uterus containing fibroids, a large tumor of the anterior wall may prevent palpation of the fetus and

## FIBROMYOMA OF THE UTERUS IN RELATION TO PREGNANCY

WITH REPORT OF CASES<sup>1</sup>

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**F**IBROMYOMATA of the uterus have caused sterility, have produced abortions and premature labors, and have caused serious complications during pregnancy, labor, and the puerperium. Myomectomy has made pregnancy possible for women who were sterile on account of fibroids, and myomectomy for fibroids which became degenerated or twisted during pregnancy has saved mother and unborn child from disaster. The relations between fibromyoma of the uterus and pregnancy are of interest to surgeons and obstetricians. It has, therefore, seemed worth while to summarize these relations, to give statistics of 147 women for whom fibromyomata were removed by the writer, and to report 5 cases in brief detail.

Uterine fibromyomata may prevent pregnancy by obstructing the cervix or the uterine cavity and by altering the glandular or vascular structure of the endometrium. Sterility is said to be twice as frequent in married women with uterine fibroids as in married women in general who come under medical care (Lynch). Statistical studies of sterility in married women who have fibromyomata of the uterus often give results which are conflicting and unsatisfactory, because important causative factors as the menopause, widowhood, determination not to have children and co-existing disease of both fallopian tubes or ovaries, are not given due consideration.

The co-existence of pregnancy and uterine fibromyoma is most often found in women between the ages of 25 and 45 years. Fibromyomata clinically important from their size and situation were present in 191 cases among 30,836 pregnant women considered by Pierson, an incidence of 0.6 per cent. Of these pregnant women with complicating fibroids, 16 per cent aborted or had premature labor on account of the tumors. In a collected series of 2,274 operations for uterine fibromyoma, Noble found 13 cases of pregnancy and 7 cases of ectopic pregnancy.

During pregnancy, fibromyomata usually increase in size and become softened and sometimes flattened, and change in position as the uterus enlarges. They may remain fixed in the pelvis by impaction or by adhesions, and cause abortion at the third or fourth month of pregnancy. After parturition the tumors return to their former volume or even to smaller size, but they may, in some instances, grow more rapidly.

Urgent symptoms during pregnancy are caused by a fibromyoma when it degenerates, becomes infected, or has its circulation partially or completely interrupted by torsion. Necrosis and even suppuration may occur in a fibromyoma (Loubat, Frank, Collins Duvergey). Dangerous intraperitoneal hemorrhage may be caused by the rupture of varicose veins on the surface of a large fibroid (Ransohoff). Hoffmann has reported a successful operation in a primipara 25 years old in whom rupture of a vein on the surface of a myoma occurred on the second day post partum.

Gross degeneration is found in approximately 13 per cent of the fibromyomata removed at operation. Among 200 degenerated fibromyomata examined by Seed, there were 12 infected submucous tumors and 3 infected tumors which were subserous or interstitial.

Pyogenic foci have been observed in myomata which macroscopically were of normal structure and showed no regressive change (Klafton). Bacteriological examination of infected myomata has shown as infecting organisms in different cases streptococcus, staphylococcus, pneumococcus, micrococcus, gonococcus, colon bacillus (Collins), and Welch bacillus (Spencer).

Small interstitial tumors and some large tumors of the upper part of the uterus may produce no serious difficulty during pregnancy or delivery. A woman reported by Huet, was delivered of her eleventh child without harm.

and Creyssel collected 85 myomectomies during pregnancy, 83 abdominal and 2 vaginal, performed between 1904 and 1922. In 65 of the cases the pregnancy was not interrupted. Only 1 of the women died, the death being due to pneumonia. In 35 of the patients the record extended to the birth of a living child, and there was no case of uterine rupture in the series. In 14 cases, myomectomy was followed by abortion.

Multiple fibromyomata have been safely removed by myomectomy during pregnancy, but it would seem wiser to remove during pregnancy only the tumors which cause urgent symptoms or which threaten disaster.

Pedunculated subserous fibroids are more easily removed from the pregnant uterus than are those which are sessile or intramural. Interstitial fibromyomata have been removed without interruption of pregnancy, even when the placenta and membranes were exposed during the myomectomy and in one case (Roulland) even when the membranes were transfixed by suture.

Myomectomy for a fibromyoma of large size growing from the posterior aspect of the lower uterine segment and causing impaction of the pregnant uterus is difficult, and carries a large chance of interruption of the pregnancy, but without surgical interference in such a case abortion is practically inevitable. Tumors of the posterior uterine wall may in some cases be removed from the cul de sac by the transvaginal route during pregnancy, but on account of the difficulty of dealing with the wound in the uterus, it will be safer in most cases to remove such tumors in connection with cesarean section at or near term.

Small submucous fibroids prolapsing into the vagina during pregnancy are easily excised. Large tumors may require subdivision to permit removal. When the pedicle may be divided under the guidance of a finger a fibromyoma tightly filling the vagina may be delivered intact by incision of the perineum and repair after extraction of the tumor.

Obstructing fibromyomata of the cervix will in most cases be more easily dealt with after cesarean section at term.

In general, those fibromyomata should be removed during pregnancy which endanger the life or health of the mother, which threaten abortion and death of the fetus, which degenerate or undergo torsion, which seriously obstruct the intestinal or urinary tracts, or which obstruct the path of delivery. Spencer holds that total abdominal hysterectomy should be performed when subperitoneal or intramural fibroids are found infected. Collins has, however, reported the performance of myomectomy without interruption of pregnancy in a case in which there was colon bacillus infection of the tumor.

When normal delivery is possible, without serious danger, in spite of the presence of a uterine fibromyoma, the performance of myomectomy or of hysterectomy may be deferred until after delivery. Hysterectomy during pregnancy should be performed only when myomectomy cannot save the patient from the accidents due to the myoma or when the tumor is infected or malignant, and the operation will seldom be performed during pregnancy except in connection with cesarean section at or near term.

#### STATISTICS

Consecutive case records of 147 women for whom uterine fibromyomata were removed by the writer, were arranged and numbered chronologically in groups according to the kind of operation performed:

1 to 45, 45 abdominal myomectomies,  
46 and 47, 2 vaginal myomectomies,  
48 to 50, 3 transvaginal myomectomies,  
51 to 131, 81 supravaginal hysterectomies,  
132 to 140, 9 complete abdominal hysterectomies.

141 to 147, 7 vaginal hysterectomies.

Among the 50 myomectomy patients, there was one death, a death caused by pulmonary embolism on the fifth day in a case of large gangrenous ovarian cyst, in which the myomectomy was incidental. There were 4 deaths among the 97 hysterectomy patients; they were due to the following causes: (a) peritonitis from breaking of infected ovarian cyst during supravaginal hysterectomy (Case 65), (b) peritonitis following supravaginal hysterectomy and relief of extensive peritoneal and

auscultation of the fetal heart (Kerr) During the later months of pregnancy, the presence and presentation of the fetus may if necessary be demonstrated by X ray examination When the diagnosis is in doubt and there are no urgent symptoms, re examination after a lapse of time may often be depended upon to make matters clear Digital examination through the rectum sometimes gives information not otherwise obtained

Curettage of the uterus may be done in cases of fibromyoma with metrorrhagia in which there is the possibility of a recent early abortion Curettage in such a case may control the bleeding, permit recovery from severe anemia, and make subsequent hysterectomy safer

The possibility that a fibromyoma may be malignant and that carcinoma may be present in the endometrium must be remembered in doing myomectomy for the relief of sterility When carcinoma is suspected in the course of an abdominal myomectomy in a non pregnant woman, the uterus should be opened by hysterotomy and the endometrium examined If a malignant myoma is encountered in doing myomectomy, hysterectomy should be performed Malignant myomata are found in about 6 per cent of the cases in which women submit to operation for fibromyoma of the uterus (Evans) Nisot has reported a case of enormous sarcoma of the uterus complicating pregnancy, in which he performed hysterectomy at the fourth month of pregnancy

Some myomectomy patients have after several years developed new fibroids, necessitating hysterectomy (Boldt, Keiffer), but at this later period of menstrual activity the operatively induced menopause was of less consequence than it would have been at the time of the first operation

Myomectomy undertaken for the relief of sterility has frequently been followed by pregnancy and the delivery of a living child Lefebvre in 1912 was able to find records of 125 women who became pregnant subsequent to myomectomy McCosh has reported first pregnancies in 3 women from 30 to 38 years of age, for each of whom he had removed by abdominal myomectomy tumor weighing several pounds Twenty three married women

sterile before myomectomy performed at the Mayo Clinic have each had 1 or several children since the operation (W J Mayo) Goulloud, who has reported 15 cases of pregnancy after abdominal myomectomy holds that myomectomy offers at least a 13 per cent chance of subsequent pregnancy to married women less than 40 years of age who desire children but are rendered sterile by fibromyoma

Before undertaking myomectomy for the relief of sterility for a woman desirous of having children, the surgeon should give due consideration to any existing conditions which might make subsequent pregnancy unsafe, such as mitral stenosis, arterial hypertension, chronic nephritis In deciding upon myomectomy, he should reserve the right to do hysterectomy, in view of the fact that operation may disclose malignancy of tumors disease of both ovaries or of both tubes, or impossibility of reconstructing a uterus safe for pregnancy

Pregnancy develops normally in women who have had a myomectomy, and abortions are no more frequent than among other women Labor in women who have had a myomectomy has not been found seriously modified by the scar in the uterine wall In 100 deliveries in pregnancies following abdominal myomectomy, there were 96 normal cephalic, 1 face, and 3 breech presentations (Benolt Gonnin quoted by Lefebvre) Uterine rupture during labor after myomectomy is rare The scar of myomectomy like the scar of cesarean section may, however, weaken the uterine wall or may interfere with the action of its musculature A primipara who has had myomectomy may on account of age be slow in labor and require obstetrical or surgical assistance She should therefore have the benefit of hospital care during labor and so long as necessary thereafter

Myomectomy during pregnancy has usually been performed on account of the degeneration, torsion, impaction, or large size of a fibromyoma Of 23 women for whom myomectomy was performed during pregnancy at the Mayo Clinic 16 had intra uterine pregnancy and 11 of these were delivered of living children at full term (W J Mayo) Cotte

## CASE REPORTS

**CASE 1** Myomectomy in a woman who had never been pregnant pregnancy and delivery at term of a living child by caesarean section 16 months later

Mrs V M A, aged 35 years, had been married 8 years and had no pregnancies although desirous of having children. She had had menorrhagia and anemia for 3 years on account of multiple fibromyomata of the uterus. Hemoglobin 60 per cent erythrocytes, 2 700 000 per cubic millimeter, leucocytes 7 850 per cubic millimeter. January 17, 1923 she had appendectomy and myomectomy performed. One interstitial fibromyoma of the fundus of the uterus, the size of an orange two submucous fibromyomata 1 inch in diameter, two smaller submucous tumors, and three small interstitial tumors were removed. The hysterotomy wound was sutured in layers. Convalescence was without complications. The patient became pregnant in August, 1923 and on May 27 1924 she was delivered by caesarean section, which was necessitated by persistent occipitoposterior position of the presenting head with incomplete dilatation after 24 hours of labor. The fear of possible rupture of the uterus prevented the doing of version or other obstetrical maneuver. The child was a normal male child weighing 7 pounds 14 ounces. There were no complications. In December 1928 the mother was well although she was still anemic. The boy was thriving.

**CASE 2** Myomectomy in a woman who had had one abortion at 3 months pregnancy and delivery of living child at term 3 years after operation

Mrs Z E B aged 34 years had been married 8 years and had had only one pregnancy, in which she aborted at the third month when 31 years old. She came for repair of a right inguinal hernia and the removal of multiple fibromyomata of the uterus. Because she was desirous of having children she refused hysterectomy. April 9 1920 right inguinal herniotomy appendectomy and myomectomy were performed. Eleven fibromyomata were removed one pedunculated tumor of the fundus 2 inches in diameter 3 interstitial tumors 1 inch in diameter, and 7 smaller interstitial tumors. There were no complications. In 1921 she had menorrhagia for 3 months. Examination October 19 1921, showed the uterus retroverted and large but no fibroids were palpable. The condition was corrected by systematic taking of the knee chest position. The patient became pregnant in July 1922 and on April 4 1923 she was delivered of a normal female child weighing 8 pounds 5 ounces. Persistent right occipitoposterior position of the presenting head led to delivery by podalic version.

In December 1928, the mother was well and the daughter thriving.

**CASE 3** Myomectomy at the sixth month of pregnancy abortion of dead deformed fetus 24 hours later subsequent pregnancy and delivery of living normal child at term

## TABLE III—OBSTETRICAL EXPERIENCE OF 147 PATIENTS WHO HAD OPERATIONS FOR FIBROMYOMA

	No of women
Never married	29
Had had full term pregnancies and no abortions with a total of 123 children	52
Had had full term pregnancies and one or more abortions with a total of 45 children and 28 abortions or miscarriages	23
Had had only abortions or miscarriages with a total of 9 uterine abortions and 1 tubal abortion	9
Married women never pregnant	34

## TABLE IV—DISTRIBUTION OF MYOMECTOMY PATIENTS BY SOCIAL STATE, AGE, AND STERILITY

Single	15
Married (11 less than 40 years of age)	32*
Widowed	3
Total	50
Of 11 married women less than 40 years of age	
Had had children	5
Sterile because of hydrosalpinx	1
Had never been pregnant	3
Sterile on account of fibromyoma alone became pregnant after myomectomy and was delivered of living child (Case 1)	1
Had had one abortion no children but after myomectomy pregnant delivered of living child (Case 2)	1
Had had one abortion pregnant at time of myomectomy aborted became pregnant and was delivered of living child (Case 3)	1
Myomectomy during first pregnancy delivered of living child at term (Case 4)	1

Mrs E W 34 years old had been married 9 years was without children and was pregnant when she came to the hospital May 9 1924. She had had dilatation of the cervix and had worn a stem pessary for the relief of dysmenorrhœa. An incomplete accidental abortion at the third month of pregnancy in 1917 had required curettage of the uterus. Since puberty at 13 years of age the menstrual periods had recurred regularly at intervals of from 33 to 35 days with scanty flow for 3 days. There had been no leucorrhœa. The last menstrual period had begun November 16 1923 and the patient was almost 6 months pregnant. Following a long automobile ride May 7 1924 she began to have painful uterine contractions at intervals of one half hour and escape of blood from the vagina. There was pain in the right half of the pelvis. On examination the uterus was found to correspond in size to less than the calculated 6 months of pregnancy and there was a hard small mass to the right of the cervix apparently in the broad ligament. It was thought probable that the uterine contractions had forced one or both feet of the fetus through a ruptured area of the lower uterine segment.

At operation May 8 1924, an irregular uterine fibromyoma of the shape of a foot was found in the right broad ligament closely applied to the cervix.

TABLE I—DISTRIBUTION OF PATIENTS BY OPERATION AND SOCIAL STATE

Operation	Married	Widowed	Single	Total
Myomectomy	32	3	15	50
Hysterectomy	78	5	14	97
Total	210	8	29	147

TABLE II—DISTRIBUTION OF PATIENTS BY OPERATION AND AGE

Age in years	Myomectomies	Hysterectomies	Total
Not more than 25	1	0	1
26 to 30	4	4	8
31 to 35	13	7	20
36 to 40	10	20	30
41 to 45	13	24	37
46 to 50	4	23	27
51 to 55	3	15	18
56 years or more	2	4	6
Totals	50	97	147

omental adhesions (Case 83), (c) surgical shock following complete abdominal hysterectomy in a patient with arterial hypertension (Case 132), (d) peritonitis following complete hysterectomy in a patient with procidentia, large fibromyoma, and anaemia (Case 136)

The myoma patients who had operations are classified according to operation and social state in Table I, and according to operation and age in Table II. From the second table, it will be seen that two thirds of the myomectomies were in women from 31 to 45 years old, and two thirds of the hysterectomies were in women from 36 to 50 years of age.

The obstetrical experience of 147 patients who had operations for fibromyoma is given in Table III. Twenty nine women were unmarried, and 43 married women had no children. Of 75 women to whom a total of 168 children were born, 18 women were sterile at the time of operation for fibromyoma, as shown by the finding of double hydrosalpinx or pyosalpinx in the 18 cases (Cases 7, 45, 51, 57, 78, 86, 87, 89, 103, 108, 109, 116, 122, 128, 131, 133, 139, 147).

The 50 myomectomy patients are classified according to social state, age, and sterility in Table IV. From this table it will be seen that only 3 myomectomy patients were married, less than 40 years of age, and apparently sterile on account of uterine fibroids. One of these 3 women subsequent to operation was

delivered by caesarean section of a normal living child at term. This represents at least a 33½ per cent chance of pregnancy after myomectomy for married women less than 40 years of age who are sterile on account of fibroids and desirous of having children. Goulioud considers this chance to be at least 25 per cent.

Data concerning 50 married women with large uterine fibromyomata, in reference to sterility and fertility, are shown in Table V. There was only 1 death in this series (Case 136). Among the 50 cases were found 10 women with hæmoglobin from 18 to 50 per cent, 9 women with double hydrosalpinx, 2 women with large benign ovarian cysts, 1 woman with carcinoma of both ovaries, 1 with malignant myoma, 1 with carcinoma of the uterus, 1 with infected gangrenous myoma, 2 with calcified myoma. 2 women pregnant at the time of operation, 2 with procidentia, 1 woman yet menstruating at 58 years of age, and 2 women who required hysterectomy after previous myomectomy.

Of the 50 women, 5 had myomectomy, 45 had hysterectomy, 5 were widowed, 7 were past the menopause.

The average age of 50 patients at operation was 44.36 years, the average age of 50 patients at marriage was 22.8 years, and the average duration of co existing married state and menstrual activity 20 years.

Twenty women had children and no abortions, 8 had children with abortions, 5 had abortions or miscarriages only, 17 had no pregnancies, and the total number of children was 70, an average of 1.4 children for 50 patients.

Of 28 women who had children, 10 had had more than 2 children. The average for the 28 women was 2.5 children.

Of 28 women who had children, 18 had had no children for 10 years prior to operation, menopause, or widowhood.

Of 17 women who had had no pregnancies, 3 had bilateral hydrosalpinx and 2 had bilateral ovarian tumors. This leaves among the 50 married women with large uterine fibromyomata, 12 women who had had no pregnancies apparently because of the presence of fibroids.

TABLE V—DATA CONCERNING STERILITY FOR FIFTY MARRIED WOMEN WITH LARGE UTERINE FIBROMYOMATA—Continued

Case	Initial	Date of operation	Diameter in centimeters of tumor at time of operation	Weight in grams of tumor	Age at operation	Age at marriage	Age at menopause	Age when widowed	Years married during menstrual activity	Number of children	Number of abortions and miscarriages	Age at birth of last child	Interval between last child and operation	Remarks
18	D	9-8-27	6.5		36	18			15	2	0	25	11	Metrorrhagia Hemoglobin 65% Ovarian cystoma weighing 15 g lbs
19	A M	11-7-25		455	30	19			17	2	0	25	11	Chronic glandular endometritis
22	M H	12-25	7.5		40	23			23	1	1	25	21	Double hydrosalpinx
23	H L	2-4-20	10		36	4			12	1	3	27	21	Menorrhagia Hemoglobin 60%
24	R	6-5-25	6.5		50	18			32	4	1	33	17	Menorrhagia Hemoglobin 46%
25	I C	4-10-20	6.5		53	21			51	0	1			Retraction of uterus
26	M B	6-3-25	9		41	18			25	6	0	26	17	Menorrhagia Hemoglobin 38%
27	K I	9-6-28	7.3		47	25			22	0	0			Double Hydrosalpinx—Carcinoma of both ovaries—lymphitis
29	M	10-24-25	7.3		30	4			6	2	0	20		Menorrhagia Hemoglobin 65%
30	B B	7-8-25	12.5		48	18			20	2	2	32	16	Menorrhagia Hemoglobin 64%—Procedentia—Death peritonitis
37	A G	5-2-25	7.5		55	22	48		27	0	0			Squamous cell carcinoma of endometrium
38	M H	6-17-25	10		58	30	53		28	3	1	3	23	Irritula growing for 6 years past Caliche myomata
41	E B	1-3-25	7.5		50	25			25	4	0	31	19	Procedentia
42	B M	1-3-25	7.5		49	22			27	3	0	9	20	Hysterectomy 8 years after myomectomy—Malignant submucosa fibroid myoma—Hemoglobin 25%
Average										20.0	1.4			
Average of 25 women										2.5				

Access to the tumor was obtained by a transverse incision through the loose vesico uterine fold of peritoneum with retraction of the bladder. The tumor which was sessile but not intramural was removed without weakening of the uterine wall.

On the following day at noon about an ounce of blood escaped from the vagina and painful uterine contractions quickly brought the fetus to the perineum feet first. The fetus a female about 15 centimeters long was delivered by traction on the feet. A large sacculated encephalomeningocele was found in the occipital region and a spinal band extended almost the entire length of the spinal canal without protrusion of membranes. The fetus had the discolored appearance of having been dead for several days.

After some days the uterus was found to have become retracted and relaxed. Dilatation of the cervix permitted the escape of several ounces of dark blood. The patient's recovery was then uneventful and she left the hospital 22 days after the abdominal myomectomy.

The patient became pregnant in November 1925 and on August 11 1926 she was delivered at term

of a normal female child, weighing 9 pounds and 1 ounce. The baby presented by the vertex in right occipitoposterior position. The head was large and labor was difficult. A low forceps delivery was made by Dr J L Cooper.

In December, 1928, the mother and child were well.

CASE 4 Myomectomy at the fourth month of pregnancy delivery of a living child at term.

Mrs L H H, 35 years old, had been married for 8 years and was pregnant for the first time when she entered the hospital April 20 1926 incapacitated by a large painful mass in the left lower abdomen. Pain had first appeared 5 weeks earlier but lasted only 15 minutes and was relieved by sitting down. Pain in the left side had been brought on again by housecleaning activities and had been severe for 4 days. Since puberty at 13 years of age the menstrual periods had occurred regularly at intervals of 26 days and each had lasted 5 days with free flow and without pain. There had been no leucorrhoea, no intermenstrual bleeding and no hemorrhages. The last menstrual period began December 27 1925 but the patient believed that



TABL V—DATA CONCERNING STERILITY FOR FIFTY MARRIED WOMEN  
WITH LARGE UTERINE FIBROMYOMATA

Case number	Patient's initials	Date of operation	Diameter in centimeters of uterus or largest tumor	Weight in grams of uterus or largest tumor	Age at operation	Age at marriage	Age at menopause	Age when widowed	Years married during which sterility	Number of children	Number of abortions and miscarriages	Age at birth of last child	Interval between last child and operation	Remarks
11	VD	4-21-20		237	48	27			21	0	0			Menorrhagia Hemoglobin 66%
18	FC	6-20-20	7.5		42	23		39	16	0	2			Menorrhagia Hemoglobin 64%
21	ER	10-8-22	10		50	19	46		27	0	0			Cetobrosis 1 m high sclerosis
23	DD	2-13-24		570	41	33			8	0	0			Subsequent hysterectomy
38	EFF	4-21-26		304	38	27			8	0	0			Pregnant 1 time of operation Feb 1924 at term
57	MH	10-3-18		650	40	20			20	2	1	?		Double hydrosalpinx
59	BK	12-20-18	10		39	21			18	2	0	31	8	Metrorrhagia
61	VP	3-27-19	7.5		39	21		30	9	0	0			Left ovary 90 gms Right ovary 75 gms
62	FP	3-28-10		575	30	21			18	1	0	30	0	Left ovary an cyst 81 grams
63	EB	5-22-10		747	53	21	52		31	4	0	30	23	Pauses the menopause
64	CB	9-2-20	11.5		45	21		40	18	7	0	36	9	Hemoglobin 87%
66	LC	1-27-20	6.5		51	25			26	2	0	35	16	Menorrhagia Hemoglobin 47%—Gangrenous submucous fibroid myoma
69	FW	3-22-21		613	45	30			15	0	0			Metrorrhagia
72	LB	3-5-22	6.5		42	20			22	2	0	23	19	Menorrhagia
73	EM	3-3-22	15		46	21			25	3	0	33	23	Metrorrhagia
74	EC	8-20-22		950	44	20			24	0	0			Menorrhagia Hemoglobin 35%
75	W	9-12-22	15		48	19 & 35			29	0	0			Fibroid myomatous uterus ext. ded. to umbilicus
78	MK	5-4-23	0		55	21	52		31	1	0	23	33	Double hydrosalpinx
79	FR	6-4-23	12.5		31	17			14	3	1	27	4	Fat at the time she was pregnant
81	MM	12-12-23	10		45	30			15	0	0			Retraction of the myometrium 1 gpel 2
84	VP	4-2-24	7.5		34	18			16	0	2			Double hydrosalpinx
90	WR	8-18-24	0		48	32			16	0	0			Menorrhagia Hemoglobin 47%
91	LBR	9-2-24	10		48	16			32	3	1	27	21	Menorrhagia Hemoglobin 47%
93	JE	9-2-24		715	45	20			25	2	0	33	12	Presence of fibroid myoma
96	MB	11-6-24	6.5		33	28			5	0	0			Ovary 11 grams
99	EH	6-19-25	20		5	39	40		19	0	1			Postmenopausal
100	FM	7-6-25		820	4	21	51	24	2	1	0	23	31	Calcified fibroid myomata
102	MS	8-0-25		2250	45	18			27	4	0	34	11	Menstrual mass a pedunculated myoma. Menorrhagia Hemoglobin 51
103	MC	8-15-25	12.5		41	17			22	0	0			Double hydrosalpinx
107	EP	10-9-25	10.0		34	26			8	0	0			Leucorrhoea Postmenopausal
108	ELH	6-16-26	20	1735	39	26			13	2	0	33	6	Double hydrosalpinx
109	MC	6-30-26	10		45	19 & 28			26	0	1			Double hydrosalpinx
110	ED	7-26-26		640	53	21		43	21	2	0	24	29	Menorrhagia Hemoglobin 30%
111	FC	8-9-26	12.5		42	20			21	0	0			Menorrhagia Hemoglobin 57%
114	MH	10-17-26		395	44	26 & 43			8	2	0	3	19	Intermenstrual bleeding for 2 years
116	BR	4-7-27		1230	38	21			7	0	0			Double hydrosalpinx

TABLE V—DATA CONCERNING STERILITY FOR FIFTY MARRIED WOMEN WITH LARGE UTERINE FIBROMYOMATA—Continued

Case no.	Patient	Date of operation	Diameter of tumor in cm.	Weight in grams of tumor	Age at operation	Age at marriage	Age at menopause	Age when last menses	Years married during men. activity	Number of children	Number of abortions and miscarriages	Age at birth of last child	Interval between last child and operation	Remarks
115	A D	9-8-27	6.5		36	18			18	1	0	15	11	Menorrhagia Hemoglobin 65% Ovarian cystoma weighing 15.5 lbs
116	A M	11-7-27		455	36	19			17	2	0	25	11	Chronic glandular endometritis
117	M H	11-1-25	7.5		46	23			21	1	1	25	21	Double hydrosalpinx
118	H L	2-4-26	10		36	24			11	1	3	27	0	Menorrhagia Hemoglobin 60%
119	R	6-5-22	6.5		50	18			32	4	1	33	17	Menorrhagia Hemoglobin 46%
120	E C	4-10-8	6.5		53	2			32	0	1			Retroversion of uterus
121	M B	6-3-2	9		43	18			25	6	0	26	17	Menorrhagia Hemoglobin 38%
122	A F	9-6-8	7.5		47	25			22	0	0			Double hydrosalpinx—Carcinoma of both ovaries—Tyrph
123	G M	0-24-8	7.5		39	4			6	2	0	20	1	Menorrhagia Hemoglobin 65%
124	B B	7-8-24	12.5		48	18			20	2	1	32	16	Menorrhagia Hemoglobin 61%—Proximal—Died of peritonitis
125	A G	5-21-8	7.5		58	22	48		27	0	0			Squamous cell carcinoma of endometrium
126	M H	6-17-8	10		58	30	52		28	2	1	35	3	Irregular flowing for 6 years past Calciated myomata
127	E B	1-3-24	7.5		50	5			25	4	0	31	19	Proximal
128	B M	12-3-26	7.5		49	22			27	3	0	20	20	Hysterectomy 8 years after myomectomy—Malignant submucous fibromyoma—Hemoglobin 25%
A	22.5 for 50 p cent				44.36	22.8			20.0	1.4				
A	76 for 28 w men who b l children									2.5				

Access to the tumor was obtained by a transverse incision through the loose vesico uterine fold of peritoneum with retraction of the bladder. The tumor which was sessile but not intramural was removed without weakening of the uterine wall.

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TABLE V.—DATA CONCERNING STERILITY FOR FIFTY MARRIED WOMEN WITH LARGE UTERINE FIBROMIOMATA

Case number	Patient's initials	Date of operation	Uterus in centimeters or length of tumor	Weight in grams of tumor	Age at operation	Age at marriage	Age at menopause	Age when widowed	Years married, during which intercourse	Number of children	Number of abortions and miscarriages	Age at birth of last child	Time, in months, between last birth and operation	Remarks
12	D	4-21-20		237	43	27			21	0	0			Menorrhagia Hemoglobin 60%
18	E.C.	6-20-20	7.5		42	23		30	16	0	2			M. menorrhagia Ham glob 64%
23	E.R.	10-8-22	10		50	19	46		27	0	0			Cervicoproliferative hyperplasia
32	D.D.	2-23-24		310	42	33			8	0	0			Subsequent hysterectomy
38	F.H.	4-2-26		396	35	27			8	0	0			Pregnant at time of operation. Delivery at term
52	M.H.	10-3-18		650	40	20			20	1	1	7		Double hydrosalpinx
59	B.K.	12-20-18	10		30	21			18	2	0	31	8	Menorrhagia
61	N.P.	3-27-10	7.5		50	22		30	9	0	0			Left ovary 90 gms. Right ovary 75 gms
62	F.P.	3-18-19		575	39	21			18	2	0	30	9	Left ovarian cyst 34 gms
63	E.B.	5-22-10		747	53	21	52		31	4	0	30	23	Postmenopausal
64	C.B.	9-2-10	12.5		45	22		40	18	7	0	36	9	Ham glob 80%
66	L.C.	1-27-20	6.5		51	25			26	2	0	35	16	Menorrhagia Hemoglobin 64%—Gartner's submucous fibroid myoma
69	E.W.	3-22-21		612	45	30			15	0	0			Menorrhagia
72	L.H.	3-5-22	6.5		42	20			22	1	0	23	19	M. menorrhagia
73	E.M.	3-31-22	15		46	21			25	5	0	33	13	M. menorrhagia
74	E.C.	8-20-22		960	44	20			24	0	0			Menorrhagia Ham glob 55%
75	A.W.	9-12-22	15		48	28 & 35			29	0	0			Fibroidomatous uterus extrauterine
78	M.K.	5-4-23	10		53	21	33		51	0	0	27	33	Double hydrosalpinx
79	F.R.	6-4-23	12.5		51	27			54	5	1	27	4	Patient thought she was pregnant
81	M.M.	12-12-23	10		45	30			15	0	0			Retrospectively fibroid in filling pelvis
82	A.R.	4-2-24	7.5		34	18			16	0	1			Double hydrosalpinx
90	A.R.	8-5-24	10		48	32			16	0	0			Menorrhagia Hemoglobin 45%
91	L.B.R.	9-2-24	10		45	16			32	3	1	27	21	Menorrhagia Hemoglobin 44%
93	H.E.	9-22-24		715	45	20			5	0	0	33	12	Necrosis of fibromyoma
95	M.B.	11-6-24		625	33	28			5	0	0			Ovary 112 grams
99	E.H.	6-10-25	10		52	9	48		19	0				Postmenopausal
100	F.H.	7-6-25		819	52	22	51	24	1	1	0	23	21	Calculated fibroid myoma
101	M.S.	8-10-25		2250	45	18			27	4	0	34	11	Mass of pedunculated myoma Menorrhagia Hemoglobin 57%
102	M.C.	8-15-25	12.5		41	17			24	0	0			Double hydrosalpinx
107	L.P.	10-9-25		1020	34	26			8	0	0			Menorrhagia Pain at periods
108	E.L.H.	6-16-26	20	1753	30	26			13	2	0	33	6	Double hydrosalpinx
109	M.C.	6-30-26	10		43	19 & 28			26	0	1			Double hydrosalpinx
110	E.D.	7-26-26		940	52	21		42	21	2	0	24	29	Menorrhagia Ham glob 63%
111	F.C.	8-19-26	12.5		47	26			22	0	0			M. menorrhagia Hemoglobin 59%
112	M.H.	10-17-26		395	44	6 & 43			28	2	0	15	19	Intermittent bleeding for 2 years
116	B.R.	4-27-27		1230	38	21			7	0	0			Double hydrosalpinx

for radical operation may be necessitated by malignancy of tumors, disease of adnexa, or by impossibility of leaving a uterus safe for pregnancy

8 Myomectomy during pregnancy may be required because of degeneration, torsion, impaction, or the large size of the fibromyomata

9 Hysterectomy during pregnancy is seldom necessary, and should be done only when myomectomy cannot save the patient from accidents due to the tumor, or when there is infection or malignancy of the tumors

10 Women who have uterine fibromyomata of large size and have never been pregnant are often sterile for other reasons than the presence of the tumors, as is shown by the findings at operation given in Table V

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pregnancy commenced before that date. Vomiting began January 28, 1926, and had not been troublesome. The breasts became tender and heavy about the middle of January.

Examination revealed a loud systolic murmur at the mitral area and at the apex of the heart but there was no pretibial edema or other sign of cardiac decompensation. The uterus was found enlarged corresponding to a 4 months pregnancy and a solid tumor larger than a man's fist was found above the left uterine cornu and could be rotated upward without displacing the cervix. A diagnosis of pedunculated uterine fibromyoma was made with reservation that the tumor might have its origin from the left ovary. Urine was normal. Hemoglobin 60 per cent by Dares hemoglobinometer, erythrocytes 3,140,000 per cubic millimeter, leucocytes 9,600 per cubic millimeter.

Myomectomy was performed April 21, 1926. The pregnant uterus completely filled the pelvis. There were two small interstitial fibroids which were left undisturbed. A large fibromyoma with attachment to the anterior surface of the uterus in a circular area the size of a silver dollar was found tipped over the left broad ligament with a tendency to descend behind the uterus. The peritoneum and superficial muscular layer were divided circularly well up on the base of the tumor and the fibromyoma was peeled out from the uterine wall by sponge dissection, several blood vessels of large size being caught with forceps before being divided. The vessels were ligated and the wound was closed with sutures of chromic catgut. The uterus was not disturbed from its position, and the fibromyoma was delivered into the bowl with almost no rotation of the uterus.

The tumor weighed 14 ounces and contained fully 2 ounces of mucoid liquid content. Microscopically the specimen showed a leiomyofibroma with hyaline change and numerous areas of liquefaction, necrosis, chronic edema, no malignancy (A. S. Warthin).

Morphine was necessary for the relief of pain after operation but there were no complications and pregnancy proceeded without interruption.

The patient was delivered by Dr J. E. Cooper September 19, 1926, of a normal female child weighing 7 pounds, 10½ ounces. The fetus presented by the vertex in right occipitoposterior position and a low forceps delivery was made with rotation of the head anteriorly.

In December 1928 the patient was in good health and the baby thriving. Menstruation returned 3 months after the birth of the baby and has been regular and normal until the present time.

CASE 5. Pregnancy and uterine fibromyoma in a woman 40 years old, transverse position of the fetus in labor at term, cesarean section and supravaginal hysterectomy.

Mrs. M. G., 40 years old, had been married 20 years, had one child 12 years old and had had no other pregnancies when she came for examination October 17, 1922. For 10 days she had had pain most of the time in a rounded mass the size of a

lemon 2 inches below the umbilicus to the left of the median line of the abdomen.

Menstruation began at 13 years of age, periods recurred at intervals of 21 days, sometimes 28 days and lasted seldom more than one day. The last menstrual period began June 5, 1922, 4½ months before and since that date there had been no bleeding but considerable vaginal discharge for which she had taken a douche daily. Nausea had been present from July 20 to October 1. The diagnosis of fibromyoma and pregnancy was made and the opinion expressed that the pregnancy could be carried to term. March 6, 1923, at full term the patient had been in labor 24 hours and the position of the fetus had become transverse when after consultation with two obstetricians, cesarean section was performed and the uterus and tubes were removed by supravaginal hysterectomy. The appendix contained a fecal concretion and was removed. The uterus contained some small fibroids in addition to the intramural fibromyoma of the anterior wall which had led to the diagnosis. The child, a boy who weighed 6 pounds 10 ounces at birth, was normal. Postoperative convalescence was uneventful.

Mother and child are well at the present time.

#### CONCLUSIONS

1. There are manifold relations between fibromyomata of the uterus and pregnancy which concern surgeons and obstetricians.

2. Statistics of sterility caused by fibromyoma of the uterus if they are to be accurate must consider such factors as desire not to have children, widowhood, menopause and disease of adnexa.

3. Pregnancy and delivery may progress satisfactorily in the presence of a large uterine fibromyoma.

4. Uterine hemorrhages, breech and transverse positions of the fetus, high fetal mortality, stasis in the urinary and intestinal tracts, and sepsis are among the important effects of fibromyomata complicating pregnancy, labor, and the puerperium.

5. Diagnosis may involve great difficulty when early pregnancy is present in a fibromyomatous uterus or when a large soft fibromyoma simulates pregnancy.

6. Myomectomy is often followed by pregnancy in married women less than 40 years of age who are desirous of having children but are sterile on account of fibroids.

7. Patients for myomectomy should be carefully selected, and the right to do hysterectomy should be reserved by the surgeon,

beginning always held fast to the muellerian origin of the endometrium like growths, has interpreted bleeding, and especially periodical bleeding, as proof of the muellerian origin of such growths, and Sampson has expressed similar views. Such an assumption is, however, hardly tenable. One has but to think of supplementary and vicarious menstruation from tissues which surely have nothing to do genetically with endometrium (gums, nasal mucosa, gastric or intestinal mucosa, and so on). Again, von Franque has described a cyst of the wolffian duct with tarry blood contents, and several years ago I operated upon 2 cases, evidently also of wolffian duct origin, which likewise contained old blood, but showed none of the characteristics of adenomyositis.

In the first case M A a woman of 45 years had a cystic mass about the size of a large lemon, between the left labium majus and minus. The exact original location was hard to determine because of the size of the mass. I believed it to be a cyst of the Bartholin's duct or gland. The history of the case was that the tumor had enlarged gradually during 5 years and occasionally about the time of the menstrual period, became painful. At other times its large size was bothersome. After removal the cyst was found to be filled with dark tarry blood and was lined with columnar epithelium with here and there areas of ciliated cells.

I do not believe that we can do anything but attribute the cyst to the wolffian duct from which so many of the usual simple cysts in the lower vagina and hymen originate. The tarry contents of the cyst are interesting especially in view of the pains about the menstrual periods. One could, of course, give other derivations for this growth but the complete absence of endometrium like glands and cytogenic stroma would be hard to reconcile with this picture in view of what has just been said regarding the influence of glandular structures on the surrounding stroma. I will take this up in detail later on and also touch upon the question of the presence or absence of hemorrhage in different cases. It must however be stated immediately that hemorrhage into a cystic hollow space of the body is almost a natural occurrence (cases of Frankl Schickele, Nebesky, Lichtenstern, and others) and only shows at most that the tissue in question has a certain tendency to take part



Fig 1 Section of cervix originally diagnosed as adenomyositis of cervix by a pathologist. It represents however only a cervicitis with hyperplasia of the lymph follicles found not infrequently normally in this area. Above in the picture a large lymph follicle with germinal centers. A small lymph node is seen below the large gland to the right of the picture. Photomicrograph of a slide in the author's collection.

in the cyclic menstrual changes of the genital apparatus.

The second case Mrs F B was a woman of 32 years on whom a panhysterectomy with removal of the tubes and ovaries was done because of menorrhagia. The uterus was fibromyomatous and chronic salpingitis and numerous follicular cysts of the ovary were also present. Macroscopically nothing of importance was to be seen in any of these organs. A flap of vaginal wall however showed five small cysts up to 1 centimeter in diameter on the vaginal side of the flap. These cysts were filled with tarry blood. The cysts ran downward from the cervix in a straight line and were off to one side of the median line. They reminded one very much of the pearl string arrangement of cysts of the wolffian duct seen not infrequently in cows and pigs. Microscopical examination of numerous sections showed cysts lined with columnar epithelium. The epithelium was not preserved well enough to state definitely its type although I thought I saw cilia at

THE HISTOGENESIS OF ADENOMYOSITIS<sup>1</sup>

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ALTHOUGH von Rokitsansky in 1860 first described adenomyomata, and in his textbook of pathological anatomy in 1861 reported endometrial cysts of the ovary under the title of *cystosarcoma adenoides ovarii uterineum*, the subject did not arouse general interest until von Recklinghausen in 1893 and the years following published the results of his investigations. Since that time a huge literature has grown up about the subject of adenomyositis, adenomyosis, or endometriosis but the histogenesis of these peculiar growth formations has remained controversial. In fact today, following the brilliant work of Sampson, it is perhaps more in dispute than before.

Sampson's well known theories have stirred up the whole subject so fundamentally that a tidal wave of endometriosis has swept through the medical journals during the last few years. As always in such instances the followers of the propounder of a faith have gone farther than the master himself and threaten by their uncritical enthusiasm to discredit the painstaking and laborious efforts of the original worker. Any ovarian cyst or tumor filled with old blood is called a chocolate cyst, implying that it belongs to the category so designated by Sampson. Any area containing glands surrounded by an endometrial stroma like tissue or even without the latter is labeled "endometriosis." I feel that many of these cases especially those lacking the cytogenic stroma, are not endometriomata at all. Some for instance may be nothing but serous peritoneal cysts surrounded by an inflammatory reaction, others, normally occurring embryonal tubules (epoophoron and paroophoron). These pseudo endometrial tumors are often hard to explain were they really endometriosis so that as a result they tend to cloud still further the histogenesis of adenomyositis. While we must admit that, theoretically at least adenomyositis may occur in any area of the abdominal cavity, the matter becomes ludicrous

when a few irregular and penetrating glands surrounded by lymphoid tissue in a tonsil, for instance, are called endometriosis. We know that even in the male inflammation may produce irregular gland structures, and Friedlander has seen such pictures in granulation tissue, Lubarsch in the stomach, Orth and Richter in the intestine, and Aschoff in the gall bladder.

As an example of pseudo endometriosis, I show Figure 1. Here cervical glands are surrounded by what at first may appear to be an endometrial stroma, but is in reality only a marked hyperplasia of small round cells and of the lymphoid follicles, frequently found to a lesser extent in this region. Perhaps I am peculiarly qualified to pass on this picture since some years ago I painstakingly investigated these small lymph follicles in both the endometrium and cervix cutting thousands of sections from hundreds of specimens (96). We must remember that aside from such more or less superficial morphological resemblances, even morphological identity cannot be considered a proof of the derivation of the tissue, as Robert Meyer pointed out years ago. Cytogenic stroma surrounding glands does not mean that the tissue must be of müllerian origin, since we know that the epithelial growth influences the stroma underlying and surrounding it. Robert Meyer believes that the stroma grows first, and Lahm has recently expressed the same opinion. Benecke and Fischel, however, believe that the connective tissue growth follows the glandular growth. Which is primary and which is secondary is not of great importance to us here, since all the various investigators agree to the fact that the epithelial growth molds the character of its stroma. Instead of placing so much weight, therefore on a purely formal relationship, we should rather stress the functional identity of tissues as Robinson has recently emphasized again. We must, however, be careful as to what we interpret as evidence of functional identity. Cullen who has from the

<sup>1</sup> Presented in abstract before the Gynecological and Obstetrical Section of the New York Academy of Medicine, November 27, 1915.



Fig 4 Squamous cell or at least transitional cell nodules from the serosal surface of a fallopian tube in a case of curettage for endometrial hyperplasia and suspension of the uterus. The tubes were resected because the pictured nodule simulated tuberculosis. Unfortunately the best slides were lost the nodule on the right is folded up and the larger one on the left has some of the tissues of the musculo fibrous wall of the tube pulled over it. These are artefacts as the nodules were directly continuous with the serosa of the tube. Author's collection.

cysts solely as an illustration of the difficulties encountered in choosing a criterion which represents a safe determinant for the derivation of a given tissue in a histological picture.

Since the morphology of adenomyositis or adenomyosis, or endometriosis has been so frequently and so minutely described, I will abstain from any detailed description of these lesions and limit myself to a consideration of the various theories which have been propounded to explain them. We can classify them under the following headings:

- 1 Embryonally misplaced tissue—(a) wolffian (b) muellerian,
- 2 Postnatally displaced tissue,
- 3 Direct invasion from the endometrium or endosalpinx
- 4 Derivation from the peritoneum (serosal theory of Iwanoff and Meyer),
- 5 Metaplasia of lymph vessels and spaces,
- 6 Metastatic transplantation through the vessels especially the lymph vessels (Halban),
- 7 Transubal implantation (Sampson)

I wish one of these hypotheses has its adherents. Some men recognize all or nearly all of them. Others again pin their faith to only one theory, at times even to the point of blinding themselves to the facts which clearly make the particular concept improbable.

The earliest theory, that of von Recklinghausen, considered adenomyomata to be derived from the wolffian body, and Babes, Pick, Hartz, Pfannenstiel, Chiari, Schickele, Nebesky, Babo, Vassner, Neumann, Robert Meyer, at first, and others, Lockyer even as late as 1918, supported this view. Robert Meyer and Klein, however, soon showed that the wolffian body never descended farther than to about the insertion of the round ligament into the cornu of the uterus, so that below this point adenomyomata were henceforth attributed to changes in the wolffian duct. It is true Nagel claimed that the wolffian duct did not descend below the cervix, but this was disproved by others (Klein, Dohrn, Van Ackeren), and the wolffian theory remained in force.

Some time later, however, von Franqué succeeded in tracing out the direct connection between the endosalpinx and the so called wolffian remnants in cases of salpingitis isthmica nodosa, and although some authors regarded these lesions as true tumors (Aschoff, Brunet, Pick, Meyer, Schickele, Wolff) and Maresch thought that they arose from preformed tubal diverticula (see also Lahm) Schauta, Kehrer, Wallert and Hoehne soon agreed with von Franqué in considering



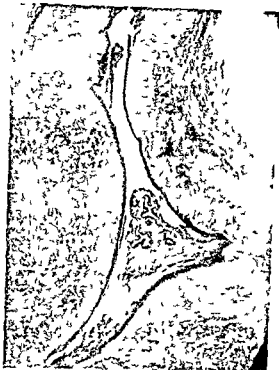


Fig 2a



Fig. b



Fig 3

Fig 2 a Cavity deep in the tissues of an ovary which was removed together with a fibromyomatous uterus and the rest of the adnexa. No signs of adenomyosis in any of the other organs. The cavity was surrounded by musculo-fibrous tissue and shows indications of a definite wall of its own. In the cavity is typical endometrium. Author's collection. b Higher power of endometrium of a.

Fig 3 Definite adenomyoma from between the folds of the broad ligament removed during a caesarean section. In the lower part of the picture is fibromuscular tissue then dilated glands of the basalis and above a marked decidual reaction. Author's collection.

one point. Remnants of blood were present. The cysts lay under the stratified squamous epithelium of the vagina and were separated from it by a thin layer of musculo-fibrous tissue. A connection between vaginal mucosa and cysts could not be seen. Evidences of injury to the vaginal wall were not present. The posterior surface of the vaginal flap, the cervix and the rest of the removed organs were entirely devoid of any similar cysts or evidence of adenomyosis.

I think that in this case, where again we see hæmorrhage, we can also, from the location and structure safely assume an origin from the wolffian duct tissue.

I cite these cases which, except for their blood contents, were simple wolffian duct

salpingitis isthmica nodosa as inflammatory. Furthermore, it was shown, since Waldeyer in 1870 first described downgrowths of germinal epithelium in the human ovary, that the medullary rays of the ovary, supposedly of mesonephric origin and considered the starting point of ovarian adenomyoma, were really only invaginations of the surface epithelium, and later the pigment sometimes seen in these "wolffian remnants" and accepted as being the same as that of Giralde's organ, was found by Cohen to be ferruginous (probably blood pigment), whereas the pigment of Giralde's organ is iron free. Aside from these points, however, we see that those tumors which we know to be of mesonephric or wolffian origin—paroophoron and epoophoron cysts—do not show the structure of adenomyomata. Nor do the wolffian remnants seen often in the ovary exhibit any special tendency to grow, and the base of the bladder, definitely of wolffian origin, although it may show marked metaplasia, has not, so far as is known up to the present time, produced a primary adenomyotic growth. Lastly, it must be admitted that from their very location alone wolffian remnants could explain but a small percentage of the occurring adenomyomata. In view of these facts the wolffian origin of adenomyomata has been dropped by most men, and I believe justly so. There is no real evidence for it, and much against it.

The second possible source of misplaced embryonal tissue is the muellerian system, and while there is proof enough that most of the cases of adenomyosis in the uterus are due to the direct extension from the endometrium, embryonally misplaced muellerian tissue as a point of origin for adenomyomata has been more or less discredited of late, and I believe not justifiably so. In fact, Cullen, Lockstaedt, Kossmann, Lichtenstern, Russell and others have always advocated the muellerian origin of adenomyomata wherever situated in contrast to the wolffian theory of the other investigators mentioned above.

When we consider that there is hardly a tissue or organ in the body of which instances of heterotopic growth have not been recorded, it would be strange indeed if muellerian tissue were not at times displaced. Muellerian tis-

sue has the peculiar ability of reacting in a special way to the ovary, so that even on the basis of pure logic, displaced muellerian tissue must at times be the source of adenomyotic growths. In addition, there is phylogenetically good cause to assume that in the ovary, for instance, muellerian tissue may occur. In the salamander after the fallopian tube directly enters the ovary, and even in so high a vertebrate as the otter the muellerian duct as a continuation of the fimbria ovarica reaches the hilus of the ovary (Kocks). Hartmann, in a recent contribution on the opossum, showed dystopic fimbriae growing on the surface of the ovary as far as 90 degrees from the normal fimbriae, and in 1926 Novak described a similar previous case of Hartmann. More important still is the fact that the location of some adenomyomata allow of no other explanation than that of misplaced embryonal remnants. The following cases I believe have their origin in such embryonal misplacements.

The first case S G. was a young girl of 22 years, who ever since she started to menstruate had increasing pain on her left side. Examination revealed a cystic tender mass the size of a grapefruit. At operation this was shown to be attached to the left cornu of the uterus. It contained a large amount of dark tarry blood. The histological picture was that of a typical adenomyoma. In view of the youth of the patient the large size of the tumor and the history of left sided pain since her first menstruation I think we must accept this case as a congenital anomaly, perhaps even as a rudimentary uterine horn.

Two other cases seen by me some years ago may also have been due to embryonally misplaced muellerian epithelium, since in both cases deep in the tissues of a uterine fibromyomata there was an adenocarcinomyoma while the endometrium of the uterus was normal. In the literature similar cases have been described by Robert Meyer, Babesiu, von Recklinghausen, and Rolly.

The next case J P. was a woman operated upon for a fibromyomatous uterus in whom the ovary (Fig. 2 a and b) was slightly enlarged contained some follicular cysts, was otherwise grossly normal but on microscopic examination showed a typical adenomyoma. Although no serial sections were made very many sections were taken from different parts of the ovary and nowhere was there any evidence of an endometrium like tumor penetrating



Fig. 5 Longitudinal section of a tube showing the outgrowth of the endosalpinx around the implanted end onto the serosa. The tubes had originally been implanted into the vagina through a slit in the posterior vault for the purpose of temporary sterilization because the patient suffered from pulmonary tuberculosis. Two years later the tubes which were thickened and tender were removed. Case originally described by A. Mayer (9). Author's collection.



Fig. 6 Cross section of tube described in Figure 5



Fig. 7 Endometrial fragment of the interval phase in the lumen of a fallopian tube. Slide seen by author photograph by courtesy of Dr. Louise Meeker of the New York Post Graduate Medical School and Hospital.

toneum The case was one of curettage and suspension of the uterus On the tubes were little milary whitish nodules which appeared to be tubercles The tubes were therefore resected The uterus was normal The curettings on examination showed only a moderate hyperplasia of the endometrium, and the nodules on the tubes proved to be made up of the epithelial masses described which were on the surface of the tube, and apparently continuous with the serosa Unfortunately, my best sections were lost in transit, so that the present picture is not so good as it might be, but it does show the character of the epithelium It is interesting in this connection that Osler, in his *Textbook of Medicine*, states that primary carcinoma of the peritoneum is frequently of squamous cell type Another instance of modification of the serosal surface of the tubes is shown in the next two pictures (Figs 5 and 6), of a case originally reported by A Mayer The fallopian tubes in this case had been transplanted into the vagina through a slit in the posterior fold for the purpose of temporary sterilization The tubes were removed later because they were thickened and tender They showed that in response to the irritation the whole tubal mucosa had grown out upon the serosa That this is not a freak reaction is proved by a similar case reported by Neu Here the tubes had become prolapsed into the vagina following vaginal hysterectomy

The serosal or coelomic histogenesis of adenomyositis has much in its favor, and the pictures produced by the invagination of the serosa, with or without accompanying cytogenic stroma, have been described so often that it will suffice here to point out that with the coelomic theory all extra uterine and many uterine cases of adenomyositis can be explained with the exception of a few such cases as have been described and pictured before Indeed, in the light of our present knowledge the coelomic theory is the only plausible one for some types of adenomyositis Thus the cases of adenomyositis of the umbilicus (Cullen Lauche Tholber and others) can be easily explained by the evagination by the yolk stalk allantois and umbilical vessels of a small piece of coelom which later

becomes embedded in the abdominal wall, whereas no other theory will do the same Despite this Cullen, Goddard, Waegeler, and others consider umbilical adenomyomata to be derived from the genital tract although they can offer no explanation of their mode of origin

The objection of O Schwarz, that the serosa cannot be the source of adenomyositis because the tubes and cervix which are even more closely related to the endometrium than the coelom seldom show adenomyositic change, is not tenable These organs have been differentiated into tissues which normally do not react to the causes producing endometrial growth and endometrial changes In fact tube and cervix react less to the ovarian influence than the serosa, and this is understandable if we consider that the serosa is less fully differentiated, more unripe, as it were, and thus more or less virgin soil as far as growth potentialities go

Another point of origin for adenomyomatous growth is supposed to be the endothelium of the vessels, especially lymph vessels and spaces (Sitzenfrey, Schottlaender, Opitz) It is certainly not infrequent to find the endothelium of the lymph vessels assume a cuboidal shape, as described by Brunet, Kroemer, Pankow, Scheib, Sitzenfrey, and others, and when such vessels become irregularly surrounded by a lymphoid stroma or an inflammatory area, a picture of adenomyositis may perhaps be simulated I have, however, never seen pictures of this type, which did more than simply resemble adenomyositis and the functional activity in the sense of the monthly cycle has never been reported The same is true of the glandular structures seen at times in the lymph glands of the pelvis Such structures were first regarded as metastases of a carcinoma, but a more thorough investigation showed that these gland like areas also occurred in simple inflammation (Robert Meyer, Falkner) in various parts of the body Therefore, the idea that these "glands" were carcinoma metastases (Wertheim, Ries) or parts of the wolffian body (Wulfig) or had any connection with adenomyositis, had to be given up I think that no one today seriously believes that adenomyomata are direct trans

from the surface of the ovary to be seen. A van Gieson stain showed abundant muscular tissue surrounding the endometrium.

Although a few muscle fibers seem at times to be produced locally in reaction to a glandular growth along with a cytogenic stroma, abundant musculature can only be explained by misplaced muellerian tissue, even wolffian structures never showing a great amount of such tissue.

The last case (Fig. 3) was a young woman never previously operated upon from whom, at the time of a cesarean section, a tumor the size of an egg was enucleated from between the folds of the broad ligament. The serosa was not involved here. Microscopically the tumor was made up of abundant muscle tissue covered with a thick layer of decidua and a few endometrial glands just above the surface of the muscle layer. Here again I believe only an embryonal misplacement can explain the lesion.

In the vagina also embryonal remnants either in the form of glands or islands of columnar epithelium have been offered in explanation of the adenomyomata or primary adenocarcinomata of the vagina (Robert Meyer, Pick, Kleinhaus, Bail, Hoehne and others). In view of the notorious instability of the line of demarcation between squamous cell epithelium and columnar epithelium around the region of the external cervical os, and the fact that cylindrical epithelium has a tendency to form glands by invagination from the surface such an assumption is not at all far fetched, as shown for instance by the papillary form of cervical erosion produced by the downgrowth of the cervical columnar epithelium. We must also remember that in early fetal life the vagina is lined with columnar epithelium, which, according to Robert Meyer, even has small glands.

While we must therefore admit that some cases of adenomyositis evidently develop from embryonally misplaced muellerian tissue, such an assumption will satisfy all requirements in but a few of the so frequent cases of adenomyositis. For this reason it was thought that postnatally displaced muellerian tissue might also give rise to heterotopic growth in some instances.

Endometrium, for example, might be transplanted traumatically or by tumor growth deep into the myometrium and grow there.

Inflammation or irritation might cause postnatal epithelial displacements and invaginations with or without metaplasia (Robert Meyer). Even the basalis of the squamous cell epithelium was considered capable of producing adenomyositis and small cystic formations of the vagina were attributed in some cases to such a change (Sitzenfrey and others). This would, however, represent only a form of adenomyositis produced by direct invasion of the surrounding structures by muellerian tissue with accompanying metaplasia. That such a process is the most usual mode in the production of adenomyositic growths of the myometrium and that metaplasia of the muellerian epithelium is not rare must be admitted without question. As far as the production of adenomyositis by the growth of misplaced endometrium is concerned we see that this concept represents but a forerunner of Sampson's theories, and since it will be taken up together with these, I will not go into the subject now. It is interesting to note that the misplaced epithelium has for years generally been conceded the power to grow.

Even postnatal misplacement, however, did not seem a sufficient basis for many adenomyomata, and it was Iwanoff and then especially Robert Meyer (also Opitz, Sames, Heine, von Rosthorn, Schottlaender, Amann and others) who showed that the serosa of the abdominal cavity was capable of transformation and would form invaginations, especially on the basis of an inflammatory reaction but also without it. Other authors (Lauche, Dietrich, and so on) held similar views and the theory certainly is plausible enough since the coelom is to be considered the progenitor of the muellerian tissue, and the germinal epithelium is really but changed serosa. Likewise the serosa shows changes in response to ovarian function, areas of cuboidal and even ciliated epithelium, and at times decidual reaction even as high up as the under surface of the liver having been described (Schmorl, Lahm, A. Mayer, Pfannenstiel, Robert Meyer, Fabricius, Pick). That the presence of cytogenic stroma offers no obstacles to such a theory has already been discussed. Figure 4 shows that even stratified or at least transitional epithelium may occur in the per-

to be a more logical explanation. At the same time, it cannot be absolutely denied that growth of implanted endometrium does not occur in some few cases, since experimentally misplaced endometrium not infrequently will grow. Stilling saw growth of endometrium transplanted into the spleen, Sochet, as mentioned, in the eye, Jacobson, Hunter Cron and Gey, O Keefe and Crossen, Katz and Szenes, all grew endometrium transplanted mostly on to the peritoneum. This last type of experiment is little conclusive to me, however, since there is no proof that the endometrium grew and that it was not the serosa which reacted by reason of the stimulation caused by the transplant. Heim, however, at the University of Tuebingen has succeeded in growing endometrium in tissue culture. We cannot, therefore deny the possibility of transplants growing but this concept is certainly not necessary, as the serosal theory will explain the lesions equally well and explain them all, which the implantation theory will not do.

As far as Sampson's transtubal transportation of either endometrium or irritating menstrual blood is concerned, it does not appear logical to me. Since the objections to this transtubal concept of Sampson have been summarized by Novak and are practically the same as the ones I laid stress upon in various discussions of the subject (New York Pathological Society and New York Academy of Medicine) I do not have to go over this whole field here but can limit myself to just a few points which seem to make transtubal implantation as a mode of disseminating endometrium at least improbable. First of all Sampson's few cases do not alter the fact that practically never does menstrual blood exude from the fallopian tubes (squeezing or stripping the menstrually congested tubes of course, being no fair test). Again, the tubal lumen, although it may at times be considered to be large enough to allow pieces of endometrium to pass through it is generally far too small for transportation of the fragments of endometrium which have been found in the tubal lumen. It is impossible even if we admit of tubal antiperistalsis, to conceive that this latter would be so systematic as to push

through a large piece of endometrium, especially in view of the recent investigations of Dryoff and Hermstein on tubal contractions, of Kok on antiperistalsis in the tubes, and of Novak on the strength and persistence of the fimbrial current. The endometrium in the few cases in which it has been seen in the tubal lumen so far has always been of the interval phase, and of the type shown in Figure 7, and so could only have been dislocated traumatically. The possibility of such endometrium ever reaching the peritoneum even if it were really viable and going up the tube, would be very small, since the dislocated fragment would probably be caught in the tubal folds, and endosalpingeal endometriosis should then occur more frequently than peritoneal implantations. Such, however, is not the case. The explanation offered for this discrepancy is that the tube is not suitable soil. This, as has been stated, holds good so far as the direct transformation of the tubal structures into adenomyositic lesions is concerned but would not be tenable for cases of simple implantation. Furthermore, that the tube can and does at times react, is shown by the not infrequent occurrence of salpingitis isthmica nodosa, and by Figures 5 and 6. Again, although carcinoma cells have been found in the tubal lumen with primary carcinoma of the uterus (Schiller von Franque and others) Novak has shown that metastases to the ovaries from the uterine cavity are rare, and when they do occur are more easily explained by the lymphatic route. Also, if implantation were a mode of spreading endometrial growths would it not be more logical to expect implants and a reaction to menstrual blood at least once in a while in the cervical canal instead of assuming that the menstrual current reverses itself and flows up into the abdomen carrying along bits of menstrual mucosa? Even if we supposed that the endometrium bathed in the lytic menstrual fluid is viable, the retrograde transport through the tube must take longer than the tissue possibly can retain its viability. Although endometrium traumatically misplaced has been grown at times, menstrual endometrium has always failed to grow except when the basalis was scraped off with it. This is true also of Heim's

formations from lymph vessels. To me at least such a belief is impossible because of the great genetic differences between lymph vessels and muellerian tissue in its widest sense. Further more since lymph vessels are present throughout the body, it would be hard indeed with such a theory to explain why adenomyositis is not found in every or any location of the body.

The metastatic theory of Halban, that is, the transportation of endometrial fragments by the lymph vessels, must be evaluated a little differently. It has just been pointed out that metaplasia of lymph vessels and inflammation in lymph glands may produce histological pictures simulating adenomyositis so that great care must be used in interpreting endometrium like areas in the lymphatics as actually being muellerian tissue. At the same time, it must be granted that pieces of endometrial tissue may perhaps at times be transported and then may be found in a vessel or space of a laboratory section, since we know, for instance, that chorionic villi are carried away sometimes by the body vessels, although such chorionic villi never grow except in cases of malignancy. Nevertheless, considering the difference in character of the placental implantation and the nonpregnant endometrium, metastatic transports from the latter must be exceedingly rare. Were such a mode of transportation a real possibility in the production of endometriosis, we should again expect adenomyositis to occur in any part of the body, but this is not so and we cannot say that endometrium, if far removed from the ovary, will not grow, since Sochet at the October meeting of the New York Obstetrical Society, reported the successful implantation of endometrium from the uterus of a guinea pig into the anterior chamber of its eye. I myself, however, have seen some cases in which endometrium appeared to be in the lymph spaces, but close examination has always shown that the invasion of the lymph vessel was from without. If fragments of endometrium really are found in the lumen of the vessels, perhaps following trauma I believe that such endometrium is either degenerating, or has reached its site artificially, since extensive adenomyositis in the lymph

vessels or spaces has never been seen. Very probably also some of the described cases of endometriosis in the lymph vessels represent but the inflammatory changes mentioned above which have nothing to do with true endometriosis.

The last theory we have to consider is Sampson's hypothesis of transplantation which has aroused so very much discussion. Sampson's theory really consists of two separate entities: one the traumatic implantation of tissue into various locations, especially the abdominal wall, following laparotomy, the other, the transubsternal implantation of endometrium into the peritoneum. We have already seen that for years the possibility of traumatic implantation has been accepted for certain rare cases. Sampson has only built up this side of the question more than had been done before. Sampson has dwelt especially upon the question of implantations of endometrium into the abdominal wound. Adenomyositis of the abdomen following laparotomy has been reported by Robert Meyer, von Franqué and Klages years ago, and later also by Fraas and Lauche but was always considered to be due to modified peritoneal serosa which had become embedded in the abdominal wound. We must bear in mind that cases of abdominal wound endometriosis are very rare in proportion to the large number of women laparotomized every day (Heaney, Danforth, and Hosoi and Meeker). Were Sampson's view in this matter correct we should, however, expect such implantation of endometrium into a laparotomy wound quite frequently. Another objection to Sampson's concept is the fact that abdominal wall endometriosis has been reported in patients in whom the uterus and tubes were not incised at all. Pankow's well known case of a girl of 5 who was operated upon for appendicitis and long after puberty developed an adenomyositis of the abdominal wall is an especially strong point against the transplantation hypothesis. Furthermore if as reported abdominal wall endometriosis following caesarean section is due to implantation why is it that there is not a clearly recognizable clinical association between ectopic pregnancy and endometriosis? Personally I believe the serosal derivation of such growths

of blood, that is, in this case, a sufficient amount of the corpus luteum hormone carried by the blood, to react. The objection that these polyps could not develop and show hyperplasia, if this were true, is not valid because the follicular hormone reaching them, even if small in amount each month, would have a cumulative action, whereas the corpus luteum action must be sufficient at one period to produce the menstrual changes and cannot in the nature of things become cumulative.

If we were to accept Sampson's theory of endometrial transplantation it would be difficult to understand why adult endometrium should not always menstruate, as indeed the endometrium penetrating the uterine wall by direct invasion usually does. If it does not it may again be due to insufficient blood supply. If, however, we adopt the serosal theory, the explanation of the hæmorrhage or menstruation being present in one case and not in another is to me at least very easy. It simply depends on whether or not the follicular hormone has sufficiently differentiated the serosa (or the embryonal rests) to allow them to function. It would lead too far to go into a more detailed discussion of this question here and the subject will be more fully taken up in a subsequent paper.

A word regarding the nomenclature of these peculiar lesions may not be amiss. They were first called adenomyomata, but we soon learned that most cases were not true tumors. Robert Meyer then called the process adenomyositis because he thought it arose on the basis of inflammation, and inflammation in some cases indeed tends to be an inciting factor as some of the illustrations shown seem to indicate. I do not believe that the inflammation *per se* is the deciding factor, and in many cases no signs of inflammation are present so that Frankl suggested the term adenomyosis instead of adenomyositis. To designate these lesions adenomyosis, however, in view of the fact that the term adenomyositis is the older term and so much better known carries the implication that one rejects altogether the inflammatory reaction as a contributory cause. Again endometriosis or muellerianosis seems to indicate that the structures are definitely of endometrial origin. It

was for this reason that, after debating the question with myself, I finally decided to use the old familiar designation adenomyositis, although I was well aware of the inaccuracy of this terminology.

### CONCLUSIONS

Considering all the various points discussed, it seems to me that aside from the direct invasion of tissues by the endometrium or endosalpinx, the serosal origin of adenomyositic lesions is to be accepted for most cases. In some rare instances (depending on the location and the amount of muscle tissue present), I believe that it is necessary to assume misplaced embryonal remnants of the muellerian system to be the origin. That transplanted endometrial tissue may at times produce endometriosis cannot be directly denied, but such cases are probably rare. Furthermore, this last source of origin is not necessary to explain the hitherto reported cases of adenomyositis.

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tissue culture experiments. The only observers who claim they grew menstrually desquamated epithelium were Cron and Gey, and since thus far they have not stated their methods or given any details, the acceptance of this fact, contrary to the opinions of all other observers, must be looked upon at least with much reserve. Furthermore, as Novak has pointed out, at the time of menstruation there is no portal of entry in the ovary for the endometrium arriving through the tubes. Again, such misplaced endometrium as has been seen in the tubes was in every instance from the upper layers of the endometrium, and thus probably has little power to grow, the basalis alone being invested with active growth potentialities.

It has also been suggested by Sampson that the menstrual blood itself passing through the tubes may set up irritation and changes in the peritoneum. Years ago Taussig made a similar suggestion. However, menstrual blood is both lytic and toxic (Frankl, Macht and Lubin, Schick), and blood, when it is found in the peritoneum, does not have to come from the tubes, since the ovaries also offer a possible source of the hæmorrhage (ruptured follicles, corpus luteum bleeding, and so on) as Spencer and Novak have emphasized. Besides, if menstrual blood has the irritating and growth producing tendencies claimed for it by Taussig and Sampson, why does it not cause occlusion of the tube, or at least a proliferation of the endosalpinx as seen in figures 5 and 6? The fact that the tubes are usually open, which Sampson considers strong evidence for his theory, is to me even greater evidence against it. That Hartmann has found dystopic fimbriæ on the ovary of the opossum, an animal which does not menstruate, must also be remembered.

The fact that in most cases the ovaries are adherent I think also suggests peritoneal irritation as the preliminary feature because the small amount and the histological picture of the endometrial tissue frequently seen in the ovaries certainly make it unlikely that such a process should have caused the adhesions. To me it seems more likely that a small ovarian hæmorrhage, for instance from a corpus luteum, occurred, and that this then pro-

duced adhesions, irritation, and secondary serosal proliferation.

As a final evaluation, the theory of trans-tubal transportation of endometrium seems to me *more unnecessary than any other hypothesis*. To explain the various lesions of adenomyosis as being the result of serosal changes offers no difficulties but to explain them by transtubal transportation means that we have to accept for granted several factors, each one of which is at least uncommon and even empirically improbable.

I want to touch on one last point, namely, that of the presence or absence of hæmorrhage, i.e., menstruation, in adenomyotic lesions. Sampson believes that this difference in reaction is due to age and the time of the menstrual cycle at which the endometrium is transplanted. This seems an inadequate explanation since endometrium viable enough to grow after transplantation must be able to react to the corpus luteum hormone, no matter at which time of the monthly cycle it was transplanted. Novak likewise does not believe in Sampson's explanation and claims that the reason that some adenomyotic growths do not menstruate is due to the fact that they are made up entirely of the basalis endometrium, which does not menstruate. He cites similar non-cyclic hyperplasia of the uterus and also the behavior of endometrial polyps some of which pass through the menstrual cycle, while others do not. Novak believes the latter to be polyps of the basalis pushed to the surface. I must admit I cannot follow Novak here at all. Since after every menstruation only the basalis is left, every endometrium represents a growth of the basalis, non-cyclic hyperplasias are due to an increased follicular activity without sufficient corpus luteum hormone. Hammond has shown in the ferret, which ovulates only on coitus, that the same hyperplastic endometrium will be carried throughout the whole heat of the animal if coitus, that is ovulation and the formation of a corpus luteum is prevented. If endometrial polyps do not share in the cyclic changes of the rest of the endometrium, it is not because they are made up of the basalis but because, being pedunculated, they do not receive a sufficient amount

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parenchyma markedly atrophied, and there was an epithelioma at the lower pole of the kidney of sufficient size to displace the dilated ureter medially. The dilatation of the ureter they considered due to interference with the normal peristalsis, as the lumen was still patent. Because of the questionable results of ureteral anastomosis and the added time required for ureteral repair many surgeons, including Floris and Migniac have ligated the proximal end of the severed ureter.

Bovee concluded, in 1896, that uretero-ureteral anastomosis was preferable to nephrectomy or ligation of the ureter. Peterson believed this conclusion substantiated by time and investigation and thought that the operation might be permanently successful. Seven months after making a ureteral anastomosis he found the repaired ureter patent but in the pyelo ureterogram there was definite dilation of the ureter and renal pelvis with a minor degree of involvement of the terminal calyces. Gouverneur interpreted the dilation of the renal pelvis in this patient as the beginning of a hydronephrosis which would eventually destroy the kidney. McEachern however, reported that in a patient of his neither the ureter nor the renal pelvis was dilated 7 years following an anastomosis after the method of Van Hook and that with the dye test indigo carmine appeared in the urine from each ureter in 5 minutes. His report indicates that a ureter may function permanently after repair and that progressive hydro uretero nephrosis with renal atrophy is not always the final result of such an operation.

The accidental division or crushing of a ureter during difficult gynecological operations has occurred occasionally even with the most experienced surgeons. While the problem presented by such an accident rarely confronts any one operator, it is still an important one. The sacrifice of a kidney is a serious matter, especially when the remaining kidney has not had opportunity for gradual compensatory hypertrophy. Consequently, ligation of the proximal end of the cut ureter or nephrectomy is a regrettable procedure. If the division of the ureter is distal enough to allow implantation of the proximal end into the bladder, that procedure is undoubtedly the one of choice.

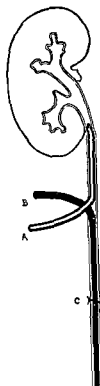


Fig. 1 Rubber urethral catheter inserted to the renal pelvis through a slit in the side of the ureter. B Second catheter or sound inserted into the ureter toward the bladder through the same slit in the ureter and over which the divided ureter is sutured C with two fine catgut sutures through all layers except the lining.

However, this method may be impossible of performance because of the high level of the division. It is apparent from clinical and experimental observation that mere suture of the ureter after division results in a low percentage of permanently functioning ureters and that a method of repair offering good chance of permanent function is needed.

Since such an operation is seldom used by any one surgeon, its technique must be simple enough to allow of efficient rapid performance without previous practice. Leakage of urine at the site of the suture must be absolutely prevented, for its occurrence causes inevitable stenosis. Interference with the flow of urine by traumatic edema at the anastomosis should not occur. Only by observation after operations satisfying these requirements can it be determined whether or not interference with

## URETERO-URETERAL ANASTOMOSIS

WARNER S BUMP M D RHINELANDER, WISCONSIN

AND

STANLEY M CROWE M D, CHICAGO

From the Joba Jay Borland Fellowship Henry Baird Fawell Laboratory St. Luke &amp; Hosp. (at) Chicago

SCHOPT in 1887 made the first attempt to unite a divided ureter in man. After severing a ureter in removing an intraligamentous cyst, he joined the ends with eight silk sutures through all layers except the lining. The patient recovered from the operation but died 7 weeks later of tuberculosis. At the postmortem examination the ureter was found firmly embedded in scar tissue. Tuffier was unsuccessful in his attempts to perform the operation in dogs in most instances because of peritonitis, and in the others because of ultimate stenosis of the ureter.

From this early work it was apparent that urine escaping at the site of the suture caused marked scar tissue formation and that the contraction of the scar tissue produced stenosis of the ureter. To avoid leakage of urine, invagination of one end in the other was attempted by such procedures as the end inside method of Van Hook and the end in end method of Pozzi. To circumvent narrowing of the ureter due to contraction in a circular scar Bovee advocated the oblique anastomosis. Judging from reports made after observation of animals for a relatively short time after the operation, the results were good with most of the methods used.

Meanwhile, reports of uretero ureteral anastomosis in man were published. Judged by the continued good health of the patient following the repair many of these operations were considered successful. Frederick in 1901, reported a patient entirely well 5 years after union of a divided ureter but in 1910 at the postmortem examination he found stenosis of the ureter and marked hydro uretero nephrosis. Obviously even with long continued absence of symptoms there still may be loss of function of the affected ureter and kidney. In 72 reports of ureteral repair collected by Peterson in 1920, postoperative examination with the cystoscope was recorded by McMonagle Lavise, and Perlis, with the cystoscope and

sounds by Bovee, Forsell, Pozzi, and Kayser and by segregation of the urine from the two ureters by Davis, Fourmier, and Reed. But these examinations, the only ones recorded in the 72 reports and made as a rule, soon after the operation gave no information as to the presence or absence of dilatation of the ureter or renal pelvis and so were of little aid in judging the final results of the operations.

From considerable experimental evidence Alksne concluded in 1909 that every ureteral repair was followed by stenosis due to traumatic edema and that atony of the ureter with loss of the normal peristalsis resulted in hydro ureter in all instances and hydronephrosis in most. Gouverneur, after making experimental observations, and studying the reports of ureteral repair in man decided that the best procedure in handling the cut ureter is uretero cystostomy but that if the location of the cut makes this maneuver impossible, end to end suture should be done. He stated that simple end to end suture is preferable to the "useless traumatism" of the Pozzi method of invagination. He believed a water tight non narrowing repair absolutely necessary, and agreed with Alksne that the "interruption by section of the musculonervous tunic" seriously interferes with the normal excretion of urine. In all his animals as in those of Alksne even with minimal cicatricial stenosis there was dilatation of the ureter at the end of 2 months. In spite of the poor late results he believed that the repair should be attempted, because gradual loss of function of the affected kidney, even though finally complete is preferable to sudden total suppression of function either by ligation of the ureter or by nephrectomy.

Bouchard and Laquiere reported an operation on a woman 19 years after a uretero ureteral anastomosis had been done. A marked hydronephrosis was found with the ureter dilated to the size of a finger and the kidney

parenchyma markedly atrophied, and there was an epithelioma at the lower pole of the kidney of sufficient size to displace the dilated ureter medially. The dilatation of the ureter they considered due to interference with the normal peristalsis, as the lumen was still patent. Because of the questionable results of ureteral anastomosis and the added time required for ureteral repair many surgeons, including Floris and Miginae, have ligated the proximal end of the severed ureter.

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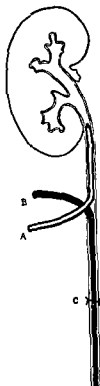


Fig. 1. Rubber urethral catheter inserted to the renal pelvis through a slit in the side of the ureter. B, second catheter or sound inserted into the ureter toward the bladder through the same slit in the ureter and over which the divided ureter is sutured. C, with two fine catgut sutures through all layers except the lining.

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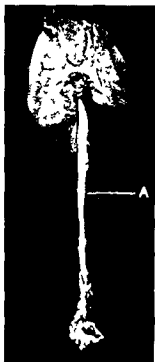


Fig 2 Photograph of the right kidney and repaired ureter of dog 41 removed 19 days after operation. A Site of suture

ureteral peristalsis alone can prevent successful result

In 1923 Dr L L McArthur was confronted with the problem of repairing a traumatically ruptured ureter, the ends of which could be brought only to within an inch of each other. Through a slit in the side of the proximal portion of the ureter he inserted a ureteral catheter distally in the ureter to the bladder bridging the gap between the ureteral ends. Through the same slit he passed a rubber catheter proximally to the renal pelvis to divert the urine from the gap in the ureter until epithelialization had occurred. The free ends of the catheters were brought out through the wound in the lumbar region.

This method not only prevents gross leakage of urine at the site of anastomosis but keeps the ends of the ureter free from the irritation of the urine while healing is in progress and insures an unobstructed flow of urine after the operation. The anastomosis is easily per-

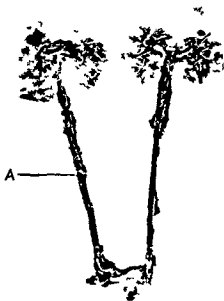


Fig 3 Photograph of both kidneys and ureters of dog 32 removed 9 months after operation. A Site of suture

formed as a water tight union is not essential. This operation applied to the occasional accident of surgical division of the ureter merits consideration. It is the purpose of this study to observe the results of this procedure in conjunction with simple end to end suture of the divided ureter.

The operation on the dog is performed retroperitoneally through a lumbar incision, essentially as described by McArthur except that two fine catgut sutures through all layers of the ureter exterior to the lining are used to bring the ends of the ureter in apposition (Fig 1). The catheter for drainage of the urine is a No 8 rubber urethral catheter which fits the lumen of the ureter snugly and prevents the flow of urine between it and the ureteral lining. The catheter over which the ureter is sutured should also fit snugly so that the full caliber of the ureter will be maintained. Ureteral and urethral catheters or small sounds may be used. The catheters are removed after 8 to 14 days. There is a urinary fistula for only a few days and inasmuch as this fistula has its origin at the slit in the

### SUMMARY OF EXPERIMENTAL OBSERVATIONS

No.	Time animal killed after operation	Condition of ureter	Condition of renal pelvis	Histological examination of kidney
41	19 days	Non narrowing healing No dilation No peri ureteral thickening (Fig. 2)	Normal	No marked change
40	22 days	Non narrowing healing No dilation No peri ureteral thickening (Fig. 1)	Normal	No marked change
19	31 days	Non narrowing healing No dilation No peri ureteral thickening (Fig. 2)	Normal	No marked change
30	50 days	Non narrowing healing No dilation No peri ureteral thickening (Fig. 1)	Normal	No marked change
39	64 days	No dilation Non narrowing healing Slight periureteral thickening not circular	Normal	No marked change
32	9 months	Slight dilation Non narrowing healing very slight periureteral thickening (Fig. 3)	Normal	No marked change

If t g al m n a t o n w a s m d f t h e k i n y n t h e l e f t h e  
n a c a n d l o o t h p o t e n c i a l k e y d f g x 1 o n e s e t i o n o f  
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k l e w t h e t h e r l i f m i n i t a n o f i t o t u s s a c h p e n e t h e  
t h e c o f o r t h e m d i l l a t o e x p t e d w t h a n c o n t e r a b l e p e n e t h e  
t h e k i n y n

ureter instead of the point of total division no constriction results. In fact the slit is practically invisible to the naked eye a few weeks after removal of the catheters. In man when the operation is performed after accidental division of the ureter the same procedure is carried out from within the abdomen the catheters being carried out through a stab wound in the abdominal wall in the lumbar region.

## RESULTS

<sup>1</sup> *Experimental observations.* In all the dogs with repaired ureters in which urinary drainage was maintained for 8 days or longer good non narrowing healing occurred. The number of these animals as listed in Table I is small because of the difficulty of maintaining urinary drainage for sufficient time in active



Fig. 4. Left pyelo ureterogram of patient taken 60 days after swing of the ureter.

animals. Twenty six dogs were operated on. Six died within 2 weeks: one from postoperative wound infection, 3 from pneumonia, and 2 during the operation. Five are still living and in 9 the catheters were dislodged before the end of the 8 day period.

*B Clinical observation* We are indebted to Drs A H Curtis and H O Jones of the gynecological service of St Luke's Hospital for permission to report these observations.

The left ureter of Mrs. L. P., age 33 years, was sutured by Dr. H. O. Jones immediately after accidental division during a difficult dissection of a large pelvic inflammatory mass. The technique of the repair was essentially as that described. However, the ureteral catheter over which the suture was performed did not fit snugly, and its distal end was left in the bladder, the opposite end remaining in the ureter. The rubber catheter had a solid tip and was fitted snugly into the ureteropelvic junction. There was absence of urinary drainage for 3 days which was probably caused



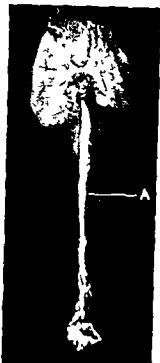


Fig. 2 Photograph of the right kidney and repaired ureter of dog 41 removed 19 days after operation. 1, Site of suture.

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Fig. 3 Photograph of both kidneys and ureters of dog 32 removed 9 months after operation. 4, Site of suture.

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rather redundant and shows an acute angulation at the level of the transverse process of the fifth lumbar vertebra. There is a short region of narrowing in the lower third of the ureter at the level of the second sacral segment. However, the opaque solution passes freely (Fig 6). (c) After the intravenous injection of one cubic centimeter of phenolsulphonophthalein, the dye appeared in the urine from the left ureter in 7.8 minutes and in that from the right ureter in 7.5 minutes. The specimens were of approximately the same depth of color and of equal amounts.

## SUMMARY

The ureters of 6 dogs, examined 19, 22, 31, 56, 64, and 270 days after division and suture, with exclusion of urine from the site of repair and with maintenance of the full caliber of the ureter, healed without narrowing or appreciable dilatation of the lumina, with a minimum scar without change in the renal pelvis and without evidence of any considerable damage to the kidneys.

Ten months after a similar operation in a woman the ureter was found to be very slightly dilated with the renal pelvis and calyces not appreciably altered.

It is realized that no final conclusions are warranted by this small series of observations over a limited period of time. Nevertheless, the results merit further careful study.

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Fig 5 Left pyelo ureterogram of patient taken 5 months after suture of divided ureter



Fig 6 Left pyelo ureterogram of patient taken 9 months after operation

by the close apposition of the ureteral lining to the opening in the side of the catheter. The rubber catheter was removed on the seventh day after the operation and the ureteral catheter 2 days later by way of the urethra. The urinary fistula was entirely closed 7 days later.

*Observation 1* 50 days after operation (a) There are no symptoms referable to the left kidney or ureter. (b) The urine from both ureters is sterile. (c) Pyelogram (Dr E L Jenkinson). The left kidney pelvis and calyces are filled with an opaque solution. They are apparently normal. The ureter is tortuous throughout and has a sharp kink at the level of the transverse process of the fifth lumbar vertebra. The ureter however is patent throughout (Fig 4).

*Observation 2* 148 days after operation (a) There are no symptoms referable to the left kidney or ureter. (b) The urine from both ureters is sterile. (c) The urine flows from both ureters in spurts. (d) Pyelogram (Dr F

L Jenkinson). The left ureter contains a catheter, is filled throughout, is rather tortuous and has a definite angulation at the level of the transverse process of the last lumbar vertebra. The left renal pelvis and calyces are filled with an opaque solution. The pelvis is normal. The calyces have retained their cupping except in the ureterogram where they appear somewhat clubbed. This may be due to increased pressure of injection (Fig 5). (e) After injection of 1 cubic centimeter of phenolsulphonephthalein intravenously the dye appeared in the urine from the left ureter in 5 minutes and in that from the right ureter in 5 5 minutes.

*Observation 3* 10 months after operation (a) There are no symptoms referable to the left kidney or ureter. (b) The urine from both ureters is sterile. (c) The urine flows from both ureters in spurts. (d) Pyelogram (Dr E L Jenkinson). The left renal pelvis and calyces are filled with an opaque solution. The calyces have retained their cupping. The ureter is

In addition to those mentioned, J. Israel, Kunith, Kleinschmidt, Abbott, Cohn, Kellock, and Cecil and Hill, have reported cases of actinomycosis involving the urinary tract alone. The ureter and bladder appear to be less often involved than the kidney, from which extension is rare. The accompanying tables show in outline the authentic cases of urinary tract invasion which we have collected. We have added one case in which there was unilateral renal actinomycosis in a patient with bilateral polycystic kidneys. The extension was apparently from the liver and the diagnosis was made at postmortem.

Israel called attention to the definite similarities between actinomycosis and tuberculosis of the kidney, in regard to pathogenesis, clinical appearance, and anatomical localization. We have found that the clinical course postoperative, is also similar to that following nephrectomy for tuberculosis. Kleinschmidt, who pointed out that actinomycosis cannot be strictly primary, in the kidney, since the "infection" is brought about by the way of the blood stream from some unrecognized colonization focus, described in his case report an apparently early and rapidly developing lesion, the kidney having preserved normal dye elimination, he described the involved area as appearing like an infarct. The salient points in diagnosis stressed by all who have reported renal cases are (1) localized pain, (2) fever and prostration, (3) muscular rigidity, (4) loss of weight, cachexia and (5) palpable tumor mass. The first three items obviously belong to an acute condition which in our opinion is likely due to secondary infection and in renal actinomycosis manifested by perinephritic suppuration. The other items suggest a chronic debilitating disease hence the natural confusion with tumor which was further enhanced in one of our own cases by the pyelographic findings and severe secondary anemia. We believe anemia is universal with long standing actinomycotic foci; it was a most important symptom in both of our cases and has not heretofore been sufficiently stressed.

Normal urine was noted in one of Israel's case reports in Kleinschmidt's record and in our first case. Hematuria occurred in the

patient upon whom Bevan made the diagnosis of renal actinomycosis, and was one of the presenting symptoms in Abbott's case and in Israel's earlier case. Our second case showed recurring hematuria, suggesting tuberculosis. In the reports of secondary renal involvement, urine changes suggest various degrees of nephritis and the finding of albumin and casts was common. Study of the urine and even of renal function does not appear of any specific aid, in that there may be variations from normal urine (in early involvement) to those changes suggesting almost any other renal disease, and finally a complete renal functional loss and the cessation of secretion in the affected kidney. Certain agglutination tests and serum reactions have been attempted as diagnostic aids. Dixon working in Warthin's laboratories, produced material corresponding to Koch's tuberculin which he called "actinomycin." In a considerable series of cases and in animal experimentation, it proved of no diagnostic value.

#### CASE REPORTS

**CASE 1.** Mr R. aged 58 years. Family history was negative. Patient had had typhoid, chicken pox, measles, whooping cough and mumps. He had lived in cities all his life and had no contact with animal.

Present illness dated back to January, 1927 when the patient consulted a physician complaining of a general run down condition, low blood pressure and an inability to gain strength or ambition. This weakness was very noticeable and was associated with gastro intestinal upsets. For 3 years previous there had been nocturia of once a night increasing during the latter part of 1926 to three or four times a night. A blood count in January, 1927 showed hemoglobin 80 per cent, red blood cells 3,940,000, white blood cells 12,250, polymorphonuclear leukocytes 74 per cent. The red blood cells were normal in size, shape and staining qualities. Urine was normal. X-ray examination showed the lungs and heart negative. A gastro intestinal series showed a pressure defect on the greater curvature of the stomach which corresponded with the position of a shadow which had the appearance of an enlarged kidney in a previous film. There also was a depression on the jejunum from the same mass. Following the barium enema there was noted a downward displacement of the splenic flexure.

Following treatment by the attending physician the patient was sent to Hot Springs, Arkansas. He was examined again at this time March, 1927. Blood pressure was 135-75. Wassermann negative. Hemoglobin 60 per cent, red blood cells 3,870,000.

## ACTINOMYCOSIS OF THE URINARY TRACT

R F CUMMING MD FACS AND R J NELSON, MD DETROIT MICHIGAN

**T**HAT actinomycosis, a parasitic disease of lower animals known familiarly as "lumpy jaw" in cattle, frequently attacks the urinary tract in the human, is a fact of which the writers were until recently only vaguely aware. A review of the literature following the belated recognition of two instances of renal actinomycosis in our own practice proves significantly a relative frequency of urinary tract involvement.

The majority of reported cases, however, are those in which the disease was secondary in the kidney, ureter, or bladder, either by direct continuity from other sources or by lymphatic or hæmatogenous extension. We wish to add to the 9 recorded cases of primary renal actinomycosis, 2 of our own, and have tabulated all available data relative to the cases on record for ready reference. Certain of our clinical notes should prove of diagnostic value. Peacock in 1925 reported a case of actinomycosis of the kidney with a brief general discussion of the disease. Certain omissions in the two pathological reports make his case somewhat questionable in spite of a convincing history. We mention this because it is often difficult to secure all the tissues desired for examination, or in fact to obtain the postmortem examinations necessary for absolute accuracy. In the 2 case records to follow, it will be apparent that autopsies were virtually impossible, that certain of our deductions are reached by reasonable exclusion and not proved by unassailable laboratory evidence.

Actinomycosis should be considered a systemic, not a local disease, hence involvement of any portion of the human body is readily understood, that selectivity does not follow although the commonest sites are the head and neck and the next most common, the abdomen. The parasite entering the digestive tract has its first opportunity there or in adjacent parts. So also, pulmonary involvement follows breathing of dust containing the organisms. Hæmatogenous dissemination may

necessitate actual lesions elsewhere for propagation and entrance to the blood stream if this is true, such a primary focus may be self limited or unrecognized.

Laboratory studies of the fungus are not altogether satisfactory, cultures from the abscesses are not often diagnostic and the presence of pyogenic bacteria prove misleading. Bevan was able to recognize the disease by the discharge from an abscess sinus although the smears were negative for actinomyces, by later tissue examination the diagnosis was confirmed. It is significant that the two conditions most often confused with actinomycosis of the kidney are tumor and tuberculosis. In his treatise on kidney tumors Garceau devotes an entire chapter to this disease.

The effects of the fungus in tissues are suppuration, necrosis granulation connective tissue formation. Thus it localizes itself to a degree, although when it involves a large area it is accompanied by a marked reaction in the surrounding parts as indicated by Bevan, who stressed the board like infiltration of the abdominal wall and flank due to a perinephritic abscess with renal actinomycosis. The individual lesion, if specifically due to the ray fungus, appears as a collection of yellowish granules of varying solidity, depending upon the age of the process. Microscopically the radiating groups of actinomyces are quite characteristic, forming a series of granules which border an abscess if such has developed. The actual diagnosis depends upon the finding of ray fungi, occasionally they can be demonstrated in the pus from an abscess, they are often present in the granulations obtained by curetting the lesion and always in the tissues themselves.

In urinary tract invasion the urine may show actinomyces; they were found in the urine following nephrectomy in Kunith's case in one of our cases organisms similar to tubercle bacilli were found and so reported by excellent laboratory workers. Other observers report this same type of bacilluria.



Fig. 2 Case 2 Left pyelogram. Note distortion of ureter and obliteration of pelvis. Perinephritic abscess present but tumor suggested by pyelogram in Case 1.

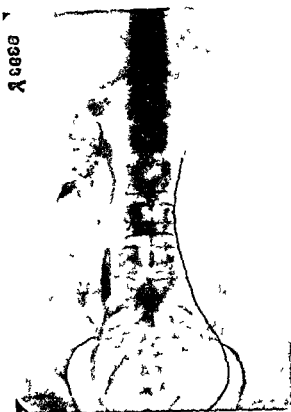


Fig. 3 Case 2 Right pyelogram. Six months after drainage of perinephritic abscess. Note dilatation of ureter and extensive changes in calyces suggesting tuberculosis. Bismuth paste in sinus below pelvis of kidney.

mesocolon and an attempt made to incise the peritoneum which, however, was so intimately adherent to the tumor as to make incision impossible. With a combination of blunt and sharp dissection the tumor was freed on all sides outside the fatty capsule. This latter structure was extremely dense and fibrous and did not contain the usual amount of fat. The principal adhesions were anterior and inferior to the kidney. Large blood vessels extending apparently from the surface of the tumor to the mesocolon and peritoneal structures were found. It was necessary to ligate several of these to control hemorrhage and facilitate the removal of the tumor. At one point the omentum was adherent through the peritoneum. The pedicle of the kidney mass including the ureter was clamped and the tumor cut away cleanly. In view of the loss of blood and poor condition of patient it was deemed advisable not to attempt ligation of the pedicle so that the wound was closed with free drainage leaving the clamps in place.

Hypodermoclysis of 1,000 cubic centimeters of saline and 10 minims of adrenalin was given immediately. The pulse being imperceptible caffeine sodium benzoate and camphor in oil were given at intervals. The patient was kept in Trendelenburg position for a considerable time in the operating room.

After operation there was a moderate amount of hemorrhage and in view of the patient's age and

secondary anemia it was thought that this might prove severe. There was definite shock. A transfusion of 500 cubic centimeters of whole blood was given 5 hours after the operation. The following morning the patient was seen by an internist in consultation who after careful examination stated that although there was some evidence of myocarditis the patient's condition was good. However the patient expired that evening having displayed a gradual lowering of blood pressure and cardiac failure. Inasmuch as the true nature of the disease was not suspected only a casual request for autopsy was made. This the family refused. The pathological report stated that the specimen had the gross appearance of hypernephroma. Microscopically the entire lesion proved to be actinomycosis.

CASE 2. Miss J. D. aged 36 years. Family history was negative. Patient had had the ordinary diseases of childhood and pneumonia and pleurisy in 1923. On October 31, 1927 an appendectomy was performed upon the patient. The pathological report was chronic atrophic appendicitis. Her convalescence for 2 weeks was uneventful. November 15 some pain was noticed in the right kidney region.

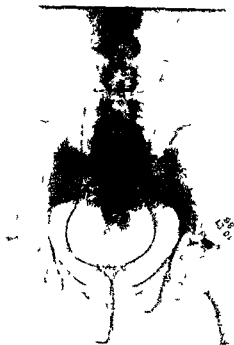


Fig 1. Case 1. Left pyelogram. Note distortion of ureter and practical obliteration of pelvis suggesting renal tumor.

white blood cells 9066 polymorphonuclear leucocytes 65 per cent. Urinalysis showed large amounts of pus cells in clumps. A cystoscopic examination revealed a normal bladder; both ureters were catheterized and specimens from the right kidney showed many pus cells in clumps and on culture colon bacilli. Specimen from the left kidney normal. Kidney function test showed a slight delay on the right side. There were no pyelograms made. A diagnosis of secondary anemia plus a pyelitis of the right kidney was made. The treatment consisted of four dilatations of the right ureter and lavage of the pelvis. The patient was reported much better after the second treatment. Iron and arsenic were given intravenously as were small doses of mercuriochrome and glucose. Following this method of treatment the urine was free from bacteria and showed only an occasional pus cell.

Upon returning to Detroit 8 weeks later his urine showed a slight trace of albumin and a moderate number of pus cells. The blood showed an increase of hemoglobin to 74 per cent, red blood cells 3,920,000, white blood cells 12,050 and polymorphonuclears 67 per cent.

June 7, 1917 the patient was referred to a urologist. A cystoscopy revealed a normal bladder; cultures from the right kidney were negative while the specimen from the left kidney cultured colon bacilli. As far as can be ascertained there was not a dif-

ferential function test and no pyelograms were taken at this time. The patient was advised to have his tonsils removed. This was done in July. He was also given intravenous injections of iron and arsenic at this time, and had two infected teeth extracted.

August 1, 1927 he consulted the writers. The blood showed at this time: hemoglobin 65 per cent, red blood cells 3,600,000, white blood cells 11,800, polymorphonuclears 58 per cent. The red blood cells showed a slight variation in size, shape and were paler than normal. Physical examination was negative except for several bad teeth and a palpable mass in the left kidney region. There had been a weight loss of 30 pounds in 8 months; this was noticeable, the patient's skin being pale and flabby. He stated positively that the mass in his upper left side had not been previously found.

Cystoscopy August 3, 1927. Bladder was normal; both ureters were patent. No. 6 catheters passed into the kidney pelves readily. Drainage was free from right; scant from left. Indigo carmine appeared in abundance from right kidney in 4 minutes and only a faint trace appeared from the left kidney 20 minutes after intravenous injection. A left pyelogram was taken with 15 cubic centimeters of sodium iodide solution. Most of this escaped into the bladder but the distorted pelvis and ureter were well outlined.

Stereoscopic films were made of the lumbar spine, pelvis and chest with single films of the femora and long bones of the upper extremity. There was no evidence of bony malignant metastases. There was a moderate bilateral apical pleuritis which was probably an old process.

The patient was referred to a clinic for complete examination. The diagnosis of renal tumor was confirmed in and 6 weeks pre-operative treatment advised. This consisted largely of a series of three blood transfusions, checked by frequent blood counts, rest and high caloric diet. Electrocardiograms, a new set of gastro-intestinal roentgenograms and daily urine studies failed to add any positive findings.

September 18, 1927 the patient entered Grace Hospital. At this time the blood showed: hemoglobin 80 per cent, red blood cells 4,040,000, white blood cells 12,400 of which 73 per cent were polymorphonuclear leucocytes. Non-protein nitrogen was 35.5 milligrams per 100 cubic centimeters. Urine showed many pus cells and amorphous crystals. Pre-operative diagnosis: malignant tumor of left kidney.

An operation was performed on September 20. A transverse abdominal incision was made extending from a point opposite the middle of the twelfth rib forward to the umbilicus. This incision was extended upward in the midline to the ensiform. The fascia and muscle including the rectus were separated in this line of incision and the peritoneum opened likewise, thus exposing the tumor mass which could be seen protruding below the costal border. A long incision was made through the



Fig. 2 Case 2 Right pyelogram Note distortion of ureter and obliteration of pelvis. Perinephritic abscess present but tumor suggested as by pyelogram in Case 1



Fig. 3 Case 2 Right pyelogram Six months after drainage of perinephritic abscess Note dilatation of ureter and extensive changes in calyces suggesting tuberculosis. Bismuth paste in sinus below pelvis of kidney

mesocolon and an attempt made to incise the peritoneum which however was so intimately adherent to the tumor as to make incision impossible. With a combination of blunt and sharp dissection the tumor was freed on all sides outside the fatty capsule. This latter structure was extremely dense and fibrous and did not contain the usual amount of fat. The principal adhesions were anterior and inferior to the kidney. Large blood vessels extending apparently from the surface of the tumor to the mesocolon and peritoneal structures were found. It was necessary to ligate several of these to control hemorrhage and facilitate the removal of the tumor. At one point the omentum was adherent through the peritoneum. The pedicle of the kidney mass including the ureter was clamped and the tumor cut away cleanly. In view of the loss of blood and poor condition of patient it was deemed advisable not to attempt ligation of the pedicle so that the wound was closed with free drainage leaving the clamps in place.

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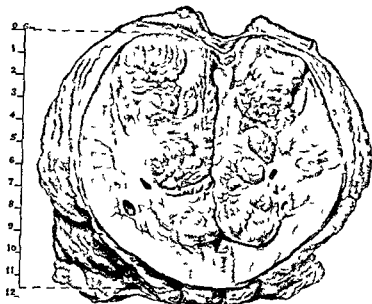


Fig 4 Case 1 Scale drawing of specimen Right kidney with fatty capsule intact Extensive involvement by actinomycosis

A diagnosis of neuritis was made at this time by the attending physician. A short time later a fair sized swelling appeared in the right lumbar region which was incised and a cupful of pus obtained. Drainage from this wound was constant. During the month of December the patient ran an afternoon temperature, had night sweats, and lost 25 pounds in weight.

She was admitted to Grace Hospital December 26, 1927, having in the meantime been referred to Dr. Frank E. Curtis with a diagnosis of tuberculosis of the spine. This condition was ruled out by X-ray with the aid of Beck's paste injected into the sinus and by laboratory study of the pus discharge. Dr. Curtis suspected a kidney condition and referred the patient to the writers. Previous to this, however, Dr. Curtis had suspected actinomycosis because of the somewhat characteristic pus and the history that the patient had spent many summers in the North of Michigan during which time the only water available for drinking purposes was that which was obtained from a spring which each winter was contaminated by cattle. Laboratory examinations, however, were negative for both actinomycosis and tuberculosis. The patient at this time showed a white blood count of 42,300 with 91 per cent polymorphonuclear leucocytes.

Cystoscopy on December 29, 1927, revealed a normal bladder throughout. Both ureters were catheterized with ease. Dye appeared from right kidney in 6 minutes and from left kidney in 4½ minutes. The dye was scant on the right. A right

pyelogram after three attempts to inject the pelvis a total of 48 cubic centimeters of sodium iodide solution being used, showed only a faint outline of the pelvis, the ureter seemingly being stretched around a tumor mass. Most of the solution was in the bladder. Guinea pigs were inoculated at this time and 6 weeks later at postmortem were negative. The differential urine showed many pus cells from the right kidney, a few from the left and negative cultures. A diagnosis of perinephritic abscess, probably tuberculous, was made at this time.

The patient continued to run a septic temperature and on December 31, 1927, the abscess was drained through a right lumbar incision. There was marked infiltration and fibrosis of the perirenal tissues and inside the fatty capsule opposite the lower pole of the kidney, a large pus pocket was found and evacuated. The kidney was free inside the fatty capsule and practically normal with the exception of the lower pole which was entirely destroyed. Palpation disclosed the renal tissue to be crushed and thread-like. The incision was left open with adequate drainage.

After operation the patient ran a temperature ranging from normal in the morning to 102-103 degrees F. in the afternoon. Blood counts showed a gradual decrease of the leucocytosis to 12,300. On January 18, 1928, the non-protein nitrogen was 4 milligrams per 100 cubic centimeters and January 30 a blood culture was negative after 72 hours. The red blood count dropped to slightly over 2,000,000 and the hemoglobin to 50 per cent. Re-

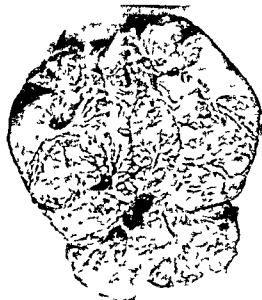


Fig 5 Case 2 Actual photograph specimen Note extensive involvement of entire left kidney Lower pole contracted following perinephritic abscess with drainage Actinomycosis only lesion found

peated examinations of the urine for acid fast bacilli were negative as were examinations of the pus for both tubercle bacilli and actinomycotic organisms. At operation the pus was again thought suspicious of actinomycosis.

A second cystoscopy on February 1 gave the same bladder findings. Upon catheterizing the right ureter an obstruction was met at 7 centimeters. After some manipulation the catheter was passed to the region of the kidney where another obstruction was met. Bilateral function as determined with phenolphthalein showed appearance from right kidney in 9 minutes and from left kidney in 4 minutes. Again the dye was scant on the right side. A pyelo ureterogram showed multiple strictures of the ureter with irregular areas of pelvic dilatation. There was pyonephrosis involving the upper and lower major caliceal areas with disturbance of the kidney substance adjacent. The pyelogram was typical of a moderately advanced tuberculosis.

A blood transfusion was given on February 10 and on the 18th the patient was discharged to return later for nephrectomy. Between this date and the second admittance the patient failed to gain in weight and strength and had a persistent purulent discharge from the sinus.

The second admittance was on April 15 1928. At this time there was a low hemoglobin and red cell count. The white blood cells had increased to 16 000 of which 90 per cent were polymorphonuclear leukocytes. Non protein nitrogen was 21 milligrams per



Fig 6 Case 1 Microphotograph specimen from left kidney Note inflammatory reaction and colonies of ray fungi

100 cubic centimeters. Two blood transfusions were given April 19 and April 24 1928. On this latter date and the following day acid fast bacilli were reported in the urine. April 25 the patient was operated under local infiltration of 3/4 per cent novocain with a preliminary administration of scopolamin and morphine. The kidney was bound down by numerous adhesions and was very difficult to free. After the application of clamps to the vascular pedicle and the ureter the kidney was removed. Because of the poor condition of the patient it was deemed advisable not to tie the pedicle and the clamps were left in the wound.

For weeks following operation the patient ran a septic temperature. She then began to complain



Fig 7 Case 2 Microphotograph specimen from right kidney Note glomeruli and colony of ray fungi

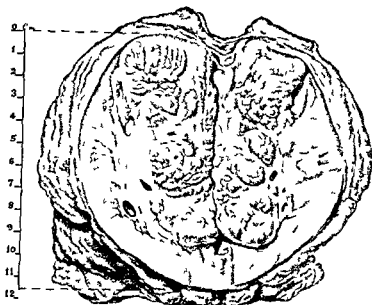


Fig. 4. Case 1. Scale drawing of specimen. Right kidney with fatty capsule intact. Extensive involvement by actinomycosis.

A diagnosis of *neuritis* was made at this time by the attending physician. A short time later a fair sized swelling appeared in the right lumbar region which was incised and a cupful of pus obtained. Drainage from this wound was constant. During the month of December the patient ran an afternoon temperature, had night sweats and lost 23 pounds in weight.

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After operation the patient ran a temperature ranging from normal in the morning to 102-103 degrees F. in the afternoon. Blood counts showed a gradual decrease of the leucocytosis to 12,300. On January 18, 1928, the non-protein nitrogen was 21 milligrams per 100 cubic centimeters and January 20, a blood culture was negative after 72 hours. The red blood count dropped to lightly over 5,000,000 and the hemoglobin to 50 per cent. Re-

TABLE III—LESIONS SECONDARY IN KIDNEY NOT ACTINOMYCOSIS

Physician	Sex and age	Primary lesion	Secondary lesion
21 Von Baracz	M 45	Lungs	Retrobronchial glands ribs and sternum Fatty degeneration in kidneys
25 Poncet and Berard	M 37	Liver	Lungs Chronic parenchymatous degeneration in kidneys
6 Duckworth	M 19	Lungs	Diaphragm slight congestion of both kidneys
27 Grill	M 26	Stomach	Lungs spleen ribs diaphragm pericardium abdominal wall chest and arm Left kidney large firm and anemic Right kidney small and congested
28 Henu	F 4	Lungs	Ve a cava per cardium Kidneys large and hard
29 Grill	M 28	Ascending colon	Liver lungs Amyloid degeneration in kidneys
30 Koch	M 28	Lungs	Pleura diaphragm colon spleen peritoneum Chronic nephritis and beginning parenchymatous degeneration
31 La ghans	M 51	Cecum and appendix	Liver Kidneys large and congested
32 Partsch	M 35	Cecum	Hip joint Amyloid degeneration of kidneys
33 Partsch	M 32	Skin	Intestines and liver Amyloid degeneration of kidneys
34 Rowland	M 27	Cecum	Lungs fatty degeneration in kidneys
35 Santorini	M 30	Lungs	Amyloid degeneration of kidneys
36 Schabald	M 62	Lungs	Pleura and ribs Interstitial nephritis chronic
37 Weigert	M 35	Skin	Pleura diaphragm liver Kidneys enlarged amyloid degeneration

TABLE IV—KIDNEY PRINCIPALLY AFFECTED

Physician	Sex and age	Primary lesion	Secondary lesion
38 Eal	M 49	Kidney ?	Brain—In kidney the lower third was a firm mass with a number of small cavities in groups and containing thick yellow pus
39 Mantion	M 53	Intestine	The pyramids and cortex of the kidneys were streaked with yellowish gray lines of purulent infiltration Many abscesses with typical colonies

TABLE V—TO URETER BY CONTINUITY

Physician	Sex and age	Primary lesion	Secondary lesion
4 Amyntory	M 25	Appendix	Focus in appendix with extension to the ureter and bladder

It is interesting to note the early diagnoses made in these cases of so called primary actinomycosis. As stated, Bevan recognized the true condition, Kleinschmidt operated for a renal mass, not recording a diagnosis, Peacock suspected tuberculosis of the involved kidney. In our second case, thinking we had ruled out actinomycosis, and having found acid fast bacilli in the urine, a pre-operative diagnosis of tuberculosis was made. This patient presented the wooden infiltration over an extensive area along the lumbar muscles adjacent to the spine and also anteriorly as far as the mid line, said by Bevan to be suggestive of actinomycosis. This was the likely basis for the early diagnosis of vertebral tuberculosis. The perinephritic abscess did

not entirely disappear after incision but remained present until after nephrectomy. Israel's earlier case, treated over 4 years for hæmaturia and suppurative pyelitis including nephrotomy, finally developed nodules in the superficial part of the lumbar scar, following the incision of these a permanent fistula developed with purulent discharge in which actinomyces were found. So with a positive diagnosis, nephrectomy was performed. Israel's second case was operated upon with a diagnosis of suppurating perinephritis as was that of Kumth. In two of the remaining instances (Abbott's case and our second case) a pre-operative diagnosis of malignant renal tumor was made with logical evidence clinical and urological. Summarizing the diag-

TABLE I—TO KIDNEY BY METASTASIS

Physician	Sex and age	Primary lesion	Secondary lesion
1 J. I. Ael	F 39	Lung	Both kidneys enlarged and pale and showed many abscesses. Masses of organisms found
2 J. Israel	F 51	Doubtful	Mastoid, breast, spleen, liver and brain. Left kidney showed many abscesses with typical pus
3 O. Iscl	F 44	Doubtful	Lungs, diaphragm, spleen, stomach and one kidney
4 Kohler	F Adult	Skin	Brain, lungs, spleen and others. Cortical abscesses in both kidneys
5 F. B. Millry	F Adult	Doubtful	Liver, lung, brain. Large cortical abscesses in kidneys
6 Miran	M 15	Mouth	Spleen and lungs. Cortical abscesses and parenchymatous degeneration in both kidneys. Organisms in abscesses
7 Moody	M 43	Upper jaw	Liver. Left suprarenal capsule. Suppurative process in left kidney
8 Moondorf	M 21	Lung	Kidney, heart. Left kidney enlarged with a purulent focus filled with granules
9 Petroff	M 26	Jaw	Abscesses in both kidneys (all characteristic organisms)
10 Poncet and Beard	M 48	Lungs	Miliary abscesses in kidneys
11 S. B. Ozols and Revère	M 32	Doubtful	Brain and suppurative kidney infection
12 J. E. Davis and R. E. Cumming	F 40	Liver	Bilateral polycystic kidneys and actinomycosis of kidney

TABLE II—TO KIDNEY BY CONTINUITY

Physician	Sex and age	Primary lesion	Secondary lesion
13 Crill	F 25	Right lumbar region	Appendix, cervical purulent focus in right kidney
14 Crill	F 25	Cervical region	Liver and kidney
15 Aschff	F	Face	Liver, left kidney pale and cloudy with nodules on surface
16 Hoover	M 43	Jaw	Neck, chest, liver, spleen, lung and both kidneys
17 Rowland	M 22	Carious tooth	Lungs, caecum, appendix, thick. Left kidney pelvis filled with pus, deposits of actinomycosis in lower third of organ also amygdalitis
18 Vandensteden	M 22	Lungs	Liver, right kidney grayish with purulent infiltration and dense wall of capsule
19 F. Nick	F 24	Tonsils	Lungs, diaphragm, liver and abscesses in both kidneys
20 Crill	M 15	Rectum	Abscess extending from appendix and involving right kidney
21 Langenbeck	M Adult	Doubtful	Prevertebral abscess extending to and involving left kidney
Crill	M 50	Appendix	Abscess extending to right kidney and liver
3 Crill	M 51	Colon	Extending to right kidney and liver

of some pain in the left shoulder and left leg. This developed into pyemic abscesses: (1) left shoulder joint posteriorly, (2) left thigh middle and lower third and (3) left leg, inner surface upper one third. These were incised on June 1 by Dr. Curtis and pus obtained from all the wounds. This cultured pure staphylococcus and in smears did not show actinomycetes. These wounds drained for a considerable length of time and finally healed. Meanwhile the kidney had been sectioned and the pathologist reported actinomycosis. Increasing doses of potassium iodide were then given and during the next 8 weeks blood transfusions were given; the severe anemia having persisted.

The lumbar wound healed completely in 2 weeks. On or about July 1, 1928 the urine began to show

blood and on July 14 while sitting up the patient's jaws became set and the muscles of the arms began to twitch and finally go into tonic contractions. This lasted about 15 minutes following which the patient had a severe headache. The patient was discharged July 28, 1928 to go home after which blood was still present in the urine. In the latter part of August there developed a marked edema of the face, hands and legs. There were also intercalary attacks which were similar to the one which has been previously mentioned and on August 30 the patient expired.

As the patient's home was at a distance in the country and as neither of the writers were in attendance at that time an autopsy could not be obtained.

# SUMMARY

1 The urinary tract is a relatively frequent site of actinomycosis which should be considered a systemic not a local disease. The involvement of kidney or ureter is usually secondary, and when the process is apparently confined to the kidney, perinephritic abscess is likely to occur. Bladder involvement has not been reported in available literature.

2 The disease is recognized by finding the typical granules (ray fungi) in the urine, in pus from suppurating areas, or in the tissues themselves. The clinical course, physical findings, and urological evidence, suggest renal tuberculosis or renal tumor. Anæmia is an important sign. The correct diagnosis is rarely made prior to operation.

3 The history often establishes the possibility of actinomycosis in that knowledge of known contact with diseased animals (especially cattle) can be ascertained.

4 The prognosis is very grave, since in secondary involvement the disease is so wide spread as to be usually fatal, and when primary in the kidney, is well advanced when treatment is undertaken. Nephrectomy is the best procedure when applicable. A ray, potassium iodide and copper sulphate are recommended, but are only of accessory value after surgical drainage and removal of the affected organ.

5 We have reviewed 9 previously reported cases of so called primary actinomycosis of the kidney and added the full clinical data of 2 cases of our own.

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TABLE VI—PRIMARY ACTINOMYCOSIS OF KIDNEY

Physician	Sex and age	Summary of pathology
41 J. I. Ral	M 31	Left kidney involved. Lower third of organ practically unchanged. Upper two-thirds show characteristic actinomycotic changes. Calyculi in pelvis described as filled with mass of granules.
47 Hunt	M 45	Right kidney—enlarged nodular and hard. On section small granules are embedded throughout. All of central portion of kidney riddled with small grayish white abscesses. Lower pole showed fatty degeneration.
41 J. I. Ral	F 60	Left kidney was enlarged. In the upper half of kidney in the region of the medullary substance there was a tumor like yellowish focus containing actinomycotic granules.
44 Kinsman	M 24	Left kidney was wedge shaped. There were yellow granules consisting of a similitude of flocculent cytes surrounded by pyogenic granulation tissue which contained numerous cells. There were also pus discharges.
45 B. van	F	The kidney was incorporated in a large mass of abscesses containing abundant colonies of actinomycetes.
46 Abbott	F 45	Large, for the most part, left-sided process. Protruding from the back. The kidney section had a yellowish appearance. Large numbers of ray fungus were found in the granules at the base of the kidney.
47 Cohn	M 46	Pyelitis, prostatic prostatitis. Organisms found in urine.
48 Kellack	F	Right kidney affected. Pathology not stated.
49 Cecil and Hill	F	Pyelonephritis.
50 R. E. Cumming and R. J. Nelson	M 58	Left kidney was enlarged, 15 cm by 7 1/2 cm by 7 cm. Fatty and fibrous capsule adherent to the capsule. The right kidney was normal kidney size and the peritoneum 2 1/4 cm thick. The medulla showed a lower part contained an irregular mass which was rough and fibrous as a result of the Crocker section showed typical ray fungus and characteristic actinomycotic granules.
51 R. E. Cumming and R. J. Nelson	F 36	Right kidney was enlarged, 11 cm by 7 cm by 7 cm. Lower pole in half the size of the upper pole. Capsule densely adherent. Section showed only a little kidney tissue remaining. The block being made up of a yellowish colored tissue very dense and fibrous. Ray fungus permeated with typical granulation tissue (actinomycosis).

noses actinomycosis, 2 cases renal tuberculosis 2 cases, malignant tumor 2 cases suppurative perinephritis, 2 cases, renal mass, 1 case.

In this summary Peacock's case is included although it does not appear in our tabulated record for reasons given above. Perinephritic suppuration occurred in 5 cases.

#### PROGNOSIS

With such a small series the prognosis of urinary tract actinomycosis can be discussed with little profit. Of the 8 cases 4 apparently recovered and 4 died; all were subjected to nephrectomy. Considering all the reported instances with renal and ureteral involvement there have been few permanent recoveries. This is undoubtedly based upon the insidiousness of the disease its general dissemination and debilitating characteristics.

#### TREATMENT

If the diagnosis is made early and the active disease is confined in the kidney nephrectomy should be the obvious procedure. With peri-

nephritic suppuration it still affords the only probable cure and had best be done in two stages as advocated for serious renal and perirenal suppurative processes by Crosbie. The persistent sinuses associated with a deep seated focus are a typical surgical problem but are self healing after the removal of the kidney and simple stimulative treatment. X-ray exposure and light therapy may be of value. For the active actinomycotic process, wherever located, X-ray treatment is advocated but we have not found convincing proof of its value. It was suggested during the hospital tenancy of our second case but refused by the consulting roentgenologist due to the lack of known results and the poor condition of the patient.

Drug therapy has some theoretical value, the most widely used is potassium iodide, although Garceau stated as early as 1909 that it had proved of little aid in limitation or cure of actinomycosis. Bevan on the other hand, and more recently states that this drug is of value especially if given with copper sulphate and administered over long periods.

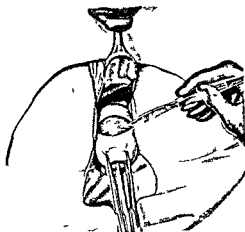


Fig. 1 Notice the wide gapping of the wound

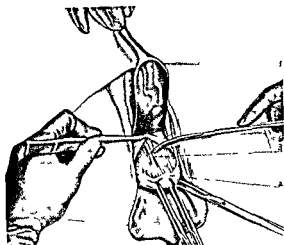


Fig. 2 Upper cut edge of the vagina lower edge of fold of connective tissue between bladder and cervix

the right layer of tissue between the bladder and anterior wall of the upper cervix, the parametrium antierius. If the incision is too far removed from the cervix we risk injuring the bladder with the first cut. The correct place for the incision is the junction between the smooth part of the mucous membrane unmovably adherent to the cervix underneath and the wrinkled movable part of the mucous membrane. When traction on the tenaculum is released that place may be distinctly seen. After having found out the right place for incision, one begins with the circumcission of the cervix with a knife in the right anterior fornix and carries the cut over the anterior wall around the cervix to the point of commencement. While doing this the operator pulls the tenacula with his left hand down to the utmost extent, while the first assistant stretches the anterior wall of the cervix by pressing the retractor into the fornix. The incision is deep enough when the transverse wound gapes at least 1 to 2 centimeters (Fig. 1).

*Step 2. Opening of anterior and posterior pouches of Douglas.* One begins by opening the vesico uterine plica. The first assistant grasps with his left hand the tenacula and pulls strongly downward while with his right hand he loosely holds the retractor in the anterior fornix so that the wall of the vagina remains slack. The operator takes in his left hand a toothed forceps and lifts the edge of the anterior vaginal wall as much as possible. This produces longitudinal folds from the cervix towards the toothed forceps. These folds are cut with curved scissors exactly midway (Fig. 2). It is not good, out of fear of injuring the bladder to keep too close to the cervix, because then one easily may get into a wrong layer, namely

into the upper layers of the cervix, where orientation is very difficult. If the vaginal wall is lifted sufficiently high we may safely cut right in the middle of the fold rather deeply without endangering the bladder. After cutting these folds the operator grasps with his left hand the tenaculum and pushes the bladder entirely off the cervix with the index finger of his right hand, the finger tip being directed toward the cervix. After a sharp dissection of the lowest fibers with scissors only loose connective tissue is left, which can be easily pushed aside with the finger. The operator must hold the tenacula himself because that gives him the bimanual feeling which enables him not to proceed too strongly or too gently with his finger, and to remain in the right layer of tissue. We are aware that the bladder is entirely moved aside and the peritoneum of the anterior pouch of Douglas freed, in the following way. First, the right index finger feels the anterior part of the cervix which is rough. This is the area from which the bladder was detached. Penetrating deeper the anterior part of the corpus feels quite smooth; a thin membrane is to be felt movable against the anterior wall of the uterus. This is the peritoneum. One must be careful to see that the bladder is stripped not only in the direction of the fundus but also sufficiently on both sides so that with the edges of the bladder the ureters are drawn back and are not injured when the parametria are ligated. As soon as the operator has felt the exposed peritoneum with his finger the first assistant grasps the tenacula with his left hand and pulls them downward, while with his right hand he cautiously inserts the retractor between the



# CLINICAL SURGERY

FROM THE RUDOLPH HOSPITAL, VIENNA

## EXTIRPATION OF THE UTERUS BY THE VAGINAL ROUTE

PROFESSOR DR. P. WERNER, VIENNA, AUSTRIA

THE advantages of vaginal extirpation of the uterus over extirpation by laparotomy are so generally recognized that I will not enlarge upon them in the present paper. Even today, however, many operators choose the abdominal method in cases which should be operated on by the vaginal route. The reason for this lies chiefly in the fact that the technical difficulties of the vaginal operation are often overestimated. As a matter of fact vaginal extirpation of the uterus is, except under especially aggravating circumstances, an easy and quickly done operation which every gynecologist should be able to perform. Yet the operation is easy and harmless only when the operator is perfectly familiar with it and is able to indicate to his assistants their necessary actions. Hardly any other operation can be made so difficult by awkwardness and lack of co-operation of the assistants as vaginal uterine extirpation. It is essential therefore that a discussion of the operation should include exact directions for the assistants.

The indications for this operation are numerous and if confined to the extirpation of the uterus alone without the adnexa include cases of hemorrhage especially in climacteric women, in adenomyosis uteri, and in cancer of the uterus also certain cases of postpartum atony, septic abortion and similar conditions. No special preparation of the patient is needed. The bowels must have been evacuated and no food is allowed on the day of operation. For anesthesia ether narcosis not especially deep is given. The patient is laid on the table in the usual position for a vaginal operation. The bladder is emptied and the vagina as well as the adjacent parts of the vulva are washed with soap and water and rinsed with a 1 per cent solution of mercury bichloride.

The operator sits before the patient, the first assistant on the left hand of the patient, the second one on her right hand.

There are two typical methods for extirpation of the uterus. One method is called 'from the

parametria'. In this procedure we first tie off the parametria and then gradually proceed by tying off the tissue against the adnexa until finally the uterus is extirpated. In the second method we begin by turning forward the corpus uteri through the anterior colporrhaphy wound, amputate the adnexa, and then tie off the parametria and cut through the posterior wall of the vagina. We call this method 'from the corpus'. The advantage of the first method is that technically it is undoubtedly very much easier, its disadvantage that with the turning forward of an enlarged uterus the ligatures formerly placed on the parametria are easily stripped off and this may cause a hemorrhage. The second method avoids this danger as the parametria is tied off last, and another advantage is that if the operator becomes aware during the operation that it is not necessary to remove the uterus, he can save the organ entirely or in part. Yet the second method is considerably more difficult to do than the first. The stripping of the ligatures can be avoided by careful tying, and on account of the greater ease of execution the first method will be described here.

*Step 1.* The vagina is opened out with two retractors, the posterior so called Martin's retractor, the anterior a short straight one. The posterior retractor is held by the second assistant with his right hand, the anterior by the first assistant also with his right hand. The operator grasps the anterior lip of the cervix with two tenacula and the posterior lip with one tenaculum and pulls the uterus down as far as possible. This is the time to circumcise the cervix. It is of the greatest importance that the right place on the anterior fornix be chosen for the incision, as this incision governs the ease with which the bladder is detached, the peritoneum is opened and if properly placed it reduces the danger of injury to the bladder. If the cut is made too low toward the lower part of the cervix and a beginner is inclined to do this, the detachment of the bladder is usually very difficult, as it is hard to get into

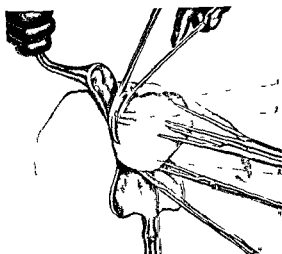


Fig 6 The uterus is turned forward. The cervix is hidden by a myoma of the anterior wall of the uterus. 1 Myoma of the posterior wall of the uterus 2 myoma of the anterior wall 3 uterine end of the right tube 4 tenacula inserted into the cervix

or silk according to one's preference portions of the tissue lying on the finger, usually half at a time are successively sutured and ligated. The following proceeding of the first assistant is recommended in order to fix the knot sufficiently far away from the cervix to get a long stump and on the other hand to be able to tie it as firmly as possible. He pulls the cervix as already mentioned as far aside as possible. Thereby the parametrium is stretched and the knot can be placed well to the lateral side. As soon as the first knot is tied the traction of the tenacula must be loosened in order to make the knot tighter in the slackened tissue and to add the second and third tie. Only when all knots are tied the cervix is pulled upon again, and the stretched tissue cut with scissors close to the cervix. The third ligature thus tied generally contains the uterine vessels. As soon as the uterine vessels have been tied off the cervix is pulled to the other side and the left parametrium is detached and ligated in the same way. When both parametria are cut off the cervix is pulled down in the median line and an anterior retractor is inserted below the bladder into the wound of the celiotomy.

*Step 4* The operator moves the tenacula up the freed anterior wall of the uterus to the fundus which he rolls forward into the vagina through traction on the tenacula (Fig 5). It is advisable to leave one tenaculum attached to the cervix so as to be able, after manipulation of the uterus to draw the cervix, which in the meantime has

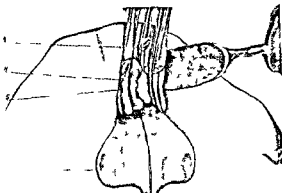


Fig 7 The uterus is free. 1 Clamp of the right adnexa and 2 and 3 clamps of the left adnexa 4 ovary and 5 tube of the right side seen between the clamps

slipped back out of the vulva. This makes the amputation of the uterus much easier. Now the whole uterus is outside the vulva and attached only by the adnexa on both sides (Fig 6).

*Step 5* *Separation of the uterus from the adnexa* One generally begins again on the right hand side. The first assistant pulls the tenacula holding the cervix and the corpus to the left hand side producing tension on the pedicle of the adnexa. The second assistant inserts the anterior retractor into the right lateral fornix thus making the adnexa more accessible. Small curved clamps of a similar shape to those used in Wertheim's operation, but much shorter, are attached beginning above with the tube and working downward and the tissue is cut close to the uterus. Generally two to three clamps are sufficient. When the pedicles of the adnexa are detached the

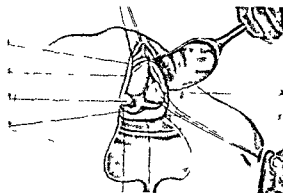


Fig 8 Fixation of the stumps on the vaginal edge. 1 anterior vaginal edge 2 peritoneum of the bladder 3 stump of the left adnexa 4 stump of the right adnexa 5 posterior vaginal edge and 6 right tube

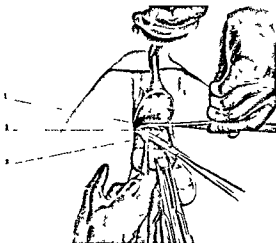


Fig. 3 The detached bladder is held back with retractor 1 Upper cut edge of the peritoneum 2 lower edge 3 anterior part of the corpus uteri

bladder and uterus This frees the peritoneum The operator takes in each hand a toothed forceps and with them lifts the peritoneum into a longitudinal fold His left hand grasps it near the cervix, that is low down his right hand near the bladder, that is high up As soon as the peritoneum is prepared in this way the second assistant takes with his left hand the anterior retractor from the right hand of the first assistant, and the first assistant takes the upper forceps with the peritoneum from the right hand of the operator The operator with his free hand now takes the scissors

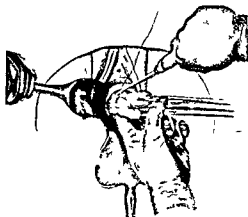


Fig. 4 The lower half of the parametrium arched forward by the finger is being tied off

and can open the peritoneum between the two toothed forceps by a transverse cut and prolong the incision to both sides (Fig 3) The upper cut edge of the peritoneum is at once fixed by means of a catgut suture to the anterior cut edge of the vagina, as otherwise it might slip back and there might arise difficulty in finding it Then follows the opening of the posterior pouch of Douglas The first assistant pulls with the right hand the tenacula holding the cervix in an upward direction toward the symphysis The operator grasps with forceps the posterior vaginal wall below the transverse incision, draws it from the uterus and cuts deepening the vaginal incision toward the cervix This generally opens the peritoneum with the first cut of the scissors The posterior flap of the peritoneum is at once sutured to the posterior edge of the vagina

*Step 3 Tying off the parametria* We generally begin with the right hand side The first assistant pulls the cervix strongly to the left, the second assistant holds with his right hand the posterior retractor while his left hand inserts an anterior retractor into the right lateral fornix This proceeding makes the parametria accessible When the parametria are tied off and separated care must be taken to keep the ligated stumps long enough so as to prevent ligatures from slipping off and causing hemorrhage It is done in the following way the operator enters his left index finger through the wound of the posterior colpotomy into the pouch of Douglas and places his finger close to the cervix under the parametria By bending his finger he arches the tissue toward himself and so makes it more accessible (Fig 4) With a Deschamps needle threaded with catgut

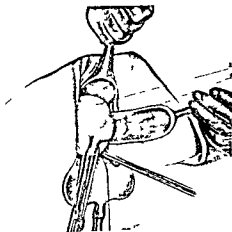


Fig. 5 It is made difficult in the presence of myomata to turn the uterus forward 1, Uterine end of the left tube 2 myoma in the posterior wall of the uterus

# FROM THE CLINIC OF THE CHICAGO LYING-IN HOSPITAL AND DISPENSARY

## TECHNIQUE OF BREECH DELIVERY

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**B**RIEF presentations demand the greatest of obstetric skill in their management. Problems such as are seldom seen in cephalic presentations are usually present, and the mortality rate is much higher both as to fetus and mother.

In this article I shall confine myself to the technique and methods used to accomplish safe delivery for both mother and baby. No hard and fast routine may be prescribed for all cases of breech presentation, each patient must be considered individually and the proper procedure followed in her given case.

The primipara gives the obstetrician the greatest concern. In her labor usually lasts longer and consequently is more painful and distressing. Not infrequently she becomes exhausted before the second stage of labor begins.

Since the breech is a poor dilator of the cervix the obstetrician should endeavor to preserve the bag of waters as long as possible. If the membranes should rupture early dilatation is prolonged and there is danger of prolapse of the cord. The latter condition is not uncommon. If the cervix is less than half dilated and the patient is not progressing it is our practice in nearly all primiparae and many multiparae to use a Voorhes bag to hasten dilatation and to prevent prolapse of the cord. A pound or a pound and a half weight is attached to the bag. The patient is examined rectally immediately the bag is expelled to determine whether or not the breech fills the cervix and if there is a prolapse of the cord. If the cord is prolapsed, the patient is immediately transferred to the operating table and placed in deep Trendelenburg or the knee-chest position until she can be prepared for examination. A vaginal examination is then made and the cord replaced over an arm if possible or it is put in a position in which pressure is least likely to compress it during a labor pain.

If possible the bag is not allowed to be expelled from the vagina. As soon as it is out of the cervix the patient is placed in the knee-chest or Trendelenburg position, the water let out of the bag and the bag removed from the vagina. After a pain or two the patient is allowed to assume the recumbent position and a rectal examination is made. The fetal heart tones are also checked.

If the cord prolapses in spite of efforts at replacement and the cervix is not completely dilated, a foot may be brought down and the cord placed above the hip. The leg is held down by light traction by the attendant during a few pains. One should never attempt to deliver the child through an undilated cervix. The baby will be lost or badly damaged in most instances and the maternal soft parts will be lacerated.

During the first stage, which is the most trying one to the patient and physician, some form of analgesia should be prescribed. We have found  $\frac{1}{6}$  to  $\frac{1}{4}$  grain of morphine sulphate to be very satisfactory. We combine it with 2 cubic centimeters of magnesium sulphate or 1/100 grain scopolamine. In some cases, especially primiparae, the Gwathmey technique is employed. The results are usually gratifying although the patient as a rule does not deliver herself.

When the second stage of labor begins the patient will need the full use of the abdominal muscles and she should be out of the state of analgesia so she will be able to coordinate the bearing down effort with the pain. The breech does not dilate the perineum and vaginal orifice as readily as the head does; therefore, this stage is usually longer in duration and requires greater effort on the part of the mother.

In all breech cases, whether we expect them to deliver spontaneously or not, a full set of instruments should be laid out. This consists of the normal labor set, the perineorrhaphy and the forceps sets. The craniotomy set is held in readiness but is not sterilized unless required.

The patient is prepared in the manner described in a previous article on Forceps Delivery.<sup>1</sup> The bladder and rectum should be emptied. She is never delivered on an ordinary labor bed, even if we expect the child to be born spontaneously since delivery of the shoulders and head may be delayed. The time consumed in changing the position of the patient may endanger the baby in spite of the assertion of Potter that 20 minutes or more may be taken in the delivery of the shoulders and head.

After the patient has been draped the procedure varies with the course of labor. In spontaneous deliveries the anesthetist gives ethylene

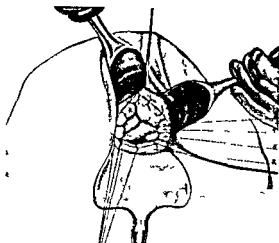


Fig 9 The stumps in fixation 1 anterior edge of vagina and peritoneum of the bladder 2 posterior edge of vagina and peritoneum of rectum 3 stump of the left tube 4 and 5 stumps of the left parametrium

uterus is free (Fig 7) The clamps are replaced by ligatures

*Step 6 Toilet of the stumps* The fixation of the peritoneum of the bladder and of the rectum to the wall of the vagina which was done at the beginning of the operation with one ligature is completed by adding two more sutures both in front and behind Then the stumps of the adnexa are sutured to the edge of the vagina (Fig 8) and lastly also the stumps of the parametria This leaves an opening leading from the vaginal cavity into the peritoneal cavity, which is edged all round with peritoneum (Fig 9)

*Step 7* Finally the peritoneal cavity is closed with a pursestring suture beginning at the peritoneum of Douglas's pouch, including the right stumps, then the peritoneum of the bladder and lastly the left stumps When catching up the stumps one should use care to include only very little tissue with the needle as otherwise there is a risk of hæmorrhage from a damaged vessel When the pursestring suture is tied the peritoneum is closed (Fig 10)

The closing of the peritoneum is not necessary to prevent a prolapse of the bowels This would not occur even if the peritoneal cavity were left wide open and only a strip of gauze inserted In such a case the remaining adnexa alone might be drawn into the vagina when the strip of gauze is removed The advantage of closing the peritoneum after fixation of the stumps is that, first, in the abdominal cavity all is smooth and no

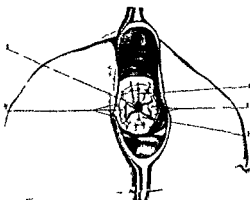


Fig 10 The peritoneum is closed 1 Purse string suture 2 peritoneum of bladder 3 peritoneum of Douglas's pouch 4 right stumps and 5 left stumps

rough area is left and second all stumps are directed into the vagina Should there occur a delayed hæmorrhage, the blood cannot penetrate the peritoneal cavity and thus be concealed, but it appears at once in the vagina and flows out of the vulva At the end of the operation a strip ofodoform gauze is placed in the vagina

#### AFTER TREATMENT

The after treatment is very simple The strip of gauze is removed on the next day On the second day after the operation an enema produces an action of the bowels, which after a vaginal operation is always much easier than after a laparotomy because the intestines have not been disturbed at all, and therefore they take up their functions more quickly On the fourth or fifth day the patient may get up, and on the eighth or tenth day as a routine she leaves the hospital Beginning on the sixth day, vaginal douches with a solution of potassium permanganate are given, and before the patient leaves the hospital she is examined on the table the vagina opened with two retractors, and the healing of the stumps is controlled If necessary the cleansing of the stumps can be accelerated by painting with iodine

With operators who use silk for ligating the vessels it may happen that the patients complain of a discharge or slight bleeding, even weeks or months after In such cases the ligatures are shed toward the vagina and appear in the vaginal lumen, and the formation of granulation tissue follows If this happens the ligature ought to be removed, and the granulation painted with silver nitrate stick.



to prevent the gloves from becoming contaminated by feces in extracting the breech, therefore this point should be thoroughly emphasized

The operator's hand the palm of which points to the baby's abdomen is inserted into the vagina and the anterior foot is sought in those cases in which the breech is low in the pelvis. If both feet are down in the pelvis, then both are grasped after the legs are straightened out, or one foot at a time may be extracted, but no traction should be used so as to displace the hips. After the feet are born traction is made in a downward and outward direction until the anterior hip presents under the pubis. It is then time to perform the episiotomy. Personally the author performs it on the left side in all cases. Many obstetricians prefer to cut the side through which the occiput will come i.e., in left presentations they do the episiotomy on the left side while in right presentations they cut the right side. The hemorrhage is controlled by means of a gauze sponge placed in the wound until the hips pass over it.

Traction is now continued in the same downward and outward direction until the anterior shoulder impinges under the pubis. No set rule is employed to deliver the arms. The anterior arm is usually brought down first. If for any reason it is difficult to extract it, the posterior arm is delivered first. Not infrequently this arm is born spontaneously. To deliver the posterior arm the body of the baby is lifted upward gently and a hand is passed into the vagina over the deltoid muscle.



The baby's arm is passed across its chest and drawn down and out of the vagina. The body is carried down until the anterior shoulder is well exposed. Two fingers of operator's opposite hand are passed over deltoid muscle of baby's arm, and the arm is gently passed across the chest and delivered over the perineum. If the arms do not come out easily, Potter's maneuver may be used.

The delivery of the arms and shoulders in many cases causes considerable trouble. If the baby is large it is often desirable to vary the usual technique somewhat and bring down the arms to the baby's side before the shoulders appear at the vulva. The same holds true in cases in which the arms have become stripped beside the head or in the nape of the neck. If this latter abnormality in position has not been noted early and one has locked the arms in place it is best to press the baby back an inch or more to loosen up the arms and to insert a hand and release the posterior arm first. The anterior arm can usually be delivered then without rotating the body so as to bring this arm posterior. If not the baby's

body should be rotated so as to bring the arm into the hollow of the sacrum. The position of the head should be carefully determined before extraction since not infrequently the head does not rotate with the back. In this case the back must be returned to its original position.

The most important and the most difficult part of the delivery is the birth of the head. If the mechanism is understood, the delivery is usually relatively easy. In a normal sized pelvis with an ordinary sized baby, the head should be placed in one of the oblique diameters with the occiput pointing anteriorly. The operator's left hand is passed into the vagina and the baby's body is placed astride the arm. The first two fingers seek the baby's maxilla. The thumb is placed on the mandible and the last two fingers fall into place on the opposite side of the child's face. Occasionally it is necessary to place the first finger in the baby's mouth at this point in order to guide the head into position. I personally prefer the right oblique diameter. I endeavor to rotate the head to that diameter in all right position breech

during the course of the pains to the point of analgesia only. The patient bears down and pulls on the straps attached to the sides of the divided labor bed or to the operating table.

In expert hands ethylene has been a very satisfactory general anæsthetic for labor cases. The anæsthetic machine should be properly grounded and also connected to the patient by means of a metal plate in contact with her body. One should not use any machine which permits gas to pass into an empty cylinder, which may cause an explosion as recently occurred. Our attitude toward ethylene has changed since the article on forceps mentioned was written. Combined with oxygen ethylene can be given safely and the tissues will not bleed excessively. Ethylene is especially valuable in breech deliveries but it requires the services of a trained anæsthetist.

In full term primiparæ and all multiparæ previously delivered by us, we do a deep medio-lateral episiotomy as soon as the anterior hip is well exposed i. e. when the vulva is dilated about 3 to 4 centimeters. For performing the episiotomy we use a light ethylene gas anæsthesia, thus allowing the patient to regain consciousness immediately. If we wish the patient to deliver the head promptly we must not give an anæsthetic to the point where she is unconscious. We make it a rule that a patient must either be lightly under the anæsthetic or must be sound asleep. In the latter case, of course, we deliver the child by breech extraction or manual aid.

If the patient is not able to deliver herself or if delivery is delayed the obstetrician should render manual aid. The breech may be lifted over the perineum by gentle traction in a downward and outward direction until the anterior hip is well under the pubis. The direction is then changed to an upward and outward pull. This assistance may be given during a labor pain. The anæsthetic is given only to the analgesic state. The patient then can usually deliver the shoulders and may be able to deliver the head also. If not, the patient is anæsthetized and one may gently insert the left hand into the vagina and deliver the head. The Smellie Veit maneuver being used.

If, in the second stage of labor, the patient is unruly or will not co-operate, the obstetrician should not hesitate to give ethylene or ethylene and ether. The anæsthetic should be pushed until complete anæsthesia is obtained. In breech extraction the muscles of the abdomen and uterus should be thoroughly relaxed. The bladder should be emptied by catheter. The perineum is then ironed out carefully so that the rectum is thoroughly emptied of its contents. It is very difficult



segment for tears and possible rupture of the uterus. This is done in all breech labors. Before the hand is inserted, the gloves should be changed and the perineum thoroughly washed with lysol solution. The vagina is opened by the insertion of the fingers palm side up, and about 1 ounce of 2 per cent mercurochrome or hexylresorcinol solution is poured into it. This is wiped over the vaginal canal in an attempt to help sterilize it. If no tears are located in the lower uterine segment, the hand is withdrawn and the special speculum previously mentioned is passed into the vagina and the cervix carefully inspected. It is repaired if necessary with interrupted 40 day chromicized No. 2 catgut.

Any lacerations of the vagina are repaired with interrupted catgut while the episiotomy wound is sewed with interrupted or continuous catgut or silkworm gut depending on the operator or the liability of infection in the particular patient.

The description given is the usual technique used in the average case with a mild flat pelvis or a normal pelvis, when the patient is under control throughout labor. If the patient comes into the hospital after being in labor for a considerable time, variations are made to suit the exigencies of the case. All breech cases should be delivered in the hospital, never in the home unless help is plentiful.

Breech deliveries in markedly flattened pelvises, in generally contracted and funnel pelvises are formidable many times. In the latter type, if the outlet is much narrowed we prefer cesarean section before the patient goes into labor or at least shortly after labor begins.

#### VARIATIONS IN TECHNIQUE

In single breech presentation (where both feet are under the chin) with premature rupture of the membranes the liquor well drained, the cervix completely dilated, and the patient exhausted the physician may be forced to deliver the patient. If the breech is well down on the perineum the extraction is not so difficult. If the breech is high and the uterus hugging the child tightly, it may be impossible to insert the hand into the uterus, to bend a leg and extract it. In such a case the author has passed a catheter over the anterior groin and then attached a wide Mayo sponge to it. The catheter is withdrawn and the gauze

placed over the child's leg as close to the groin as possible. The left hand is then placed in the vagina and the posterior groin is grasped. The right hand pulls on the gauze. In this manner the buttocks are brought down into the pelvis. As soon as the perineum begins to bulge a deep episiotomy is done. Then traction is continued until the fingers can be inserted beneath the anterior groin. Too much traction should not be used as the femur may be broken. O. Kustner<sup>1</sup> advises the use of a hook applied to the posterior hip for the same purpose. The gauze has the advantage that it is widely applied and is less apt to injure the bone or soft structures.

Wherever possible the legs of the patient should be held by assistants. This has many advantages over mechanical leg holders. In patients with flat pelvises, the legs may be dropped into the Walcher position which may give sufficient room to deliver the head. Dropping the legs into the half Walcher relieves the pressure on the perineum thus rendering it less liable to tears.

#### CRANIOTOMY ON AFTERCOMING HEAD

In patients coming to delivery with dead babies or those in which the child is lost in an attempt at delivery, it is always best to do a craniotomy on the aftercoming head. In multipara one can often deliver the head easily without damaging the maternal soft parts. A craniotomy may be done through the roof of the mouth or through the occiput. In the former case the body of the baby is lifted well up over the mother's abdomen. The lower jaw is brought down as far as possible and a Naegle perforator is pushed through the hard palate. The opening is enlarged by twisting the perforator or by inserting it in several directions.

The brain tissue is broken up by long forceps or the irrigator point. It is irrigated out of the skull by a metal irrigating point plain sterile water being used. The center piece of the cranioclast is inserted. Then the two lateral blades are attached and the fetal head extracted in the usual manner. Care should be used that the exposed spicules of bone do not injure the maternal soft parts. After the fetus is removed the entire uterine cavity should be thoroughly examined for lacerations, if any are found they should be immediately repaired.



cases This is done by gently pushing the head above the pelvic brim and rotating it anteriorly through an arc of 90 degrees If the head does not rotate easily the attempt is abandoned and delivery is affected by means of the left oblique diameter

After the head is placed in position (this is important), the operator's right hand is placed on the baby's neck, the first finger on the baby's left clavicle and the second finger on the right clavicle Do not press on the neck structures, in other words do not squeeze the neck between the fingers, for pressure is apt to injure the brachial and cervical plexuses The operator is now ready to deliver the head He should be gentle and deliberate in all maneuvers at this point It is here that the greatest damage is done to mother and baby The mother may suffer a third degree laceration or a rupture of the lower uterine segment and the baby an Erb's paralysis a fractured skull, broken neck or a rupture of the tentorium cerebri Let me repeat, be gentle and deliberate in all maneuvers from this point onward

With the head in proper position and the operator's hand properly placed traction is made in a downward outward direction The occiput is slowly brought anterior under the pubis If difficulty is experienced in bringing it down, the right hand is placed on a sterile towel over the lower uterine segment above the pubis The bark of the closed fist is used to exert pressure on the head while the vaginally placed hand guides the head into and through the pelvis Too much pressure should not be used in this maneuver, since one is liable to rupture the lower uterine segment or fracture the fetal skull The head can usually be forced down onto the perineum without trouble As the head comes down one should raise the body of the baby upward Be careful not to bring the body up too fast as the neck may be injured in this manner As soon as the mouth and nose appear the delivery of the rest of the head can be accomplished slowly since the baby can breathe without difficulty Unless there is an indication for rapid delivery, five minutes is taken to pass the head over the perineum

In a patient with a flat pelvis the delivery of the head differs somewhat from the above description In such cases the head should be placed in the transverse diameter and extended This places the widest diameter of the head to one side of the conjugata vera The head is guided into the pelvis and if the latter is not too contracted it can be passed in syntetism If the pelvis is moderately contracted posterior asymmetry should be encouraged By combined ab-

dominal pressure over the pubis and traction from below with the operator's left hand, the posterior parietal bone is drawn over the sacral promontory The anterior parietal bone can then be easily brought into the pelvic excavation This accomplished, the occiput is rotated anteriorly and the delivery is effected as described in the last paragraph

Occasionally difficulty is experienced in delivering the head within the prescribed time of 3 minutes An assistant nurse is charged with the duty of calling out the minutes as the time passes At the end of 6 or 6½ minutes the forceps should be used if the head is not delivering or easily deliverable We use the long Simpson forceps as modified by DeLee If possible the head is made to engage in one of the oblique diameters The baby is lifted up so as to make room for the application of forceps to the sides of the aftercoming head After the forceps are applied, gentle but firm traction is made in a downward and outward direction The face usually comes down on the perineum without much trouble If it does not and the time is short, and the child makes several attempts to breathe a specially constructed wide single bladed speculum is inserted over the perineum This is carried up to the child's mouth and nose, thus allowing it to breathe After it has taken several breaths of air traction is again made and the head delivered slowly At this point the head should be controlled so the perineum is not stretched too quickly, thus avoiding tears Plenty of time is taken to deliver the head since the child can breathe without interference As soon as the biparietal diameter reaches the outlet the forceps are removed the right blade being released first The head is then gently delivered over perineum

The baby is placed in a sterile towel covered tray This tray is carried on a small stand which is wheeled between the operator and the operating table After the cord toilet is attended to the baby on the stand is wheeled to the crib

As soon as the head is born ½ or 1 cubic centimeter of pituitrin is given subcutaneously This insures good uterine contraction and less hemorrhage The assistant's hand follows the uterus down without pressure or massage As soon as the placenta leaves the body of the uterus it is expressed the remaining distance by means of firm pressure on the well contracted body of the uterus Never try early expression or pull on the cord to deliver unless the uterus is firmly contracted since inversion is apt to occur

As soon as the placenta is delivered a thorough inspection is made of the lower uterine

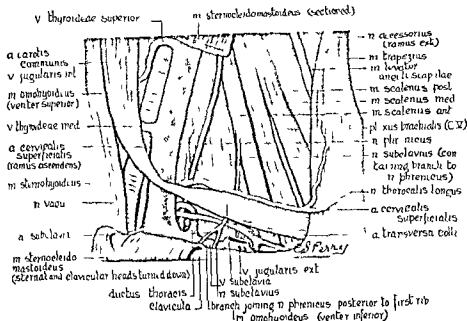


Fig 1 Anatomy of base of left neck. Sternocleidomastoid divided and turned down. All but lowest end of external jugular vein removed.

felt the tips of the transverse processes of the cervical vertebrae. The phrenic nerve springs from the third, fourth, and fifth cervical roots and passes inferiorly and medially on the anterior surface of the scalenus anticus. When the incised prevertebral fascia is retracted, the phrenic nerve may cling to its posterior surface and not be seen on the scalene. The phrenic nerve and the main nerve to the subclavius are the only nerves coming from the brachial plexus and lying between the prevertebral fascia and scalenus anticus muscle that have a mesial inclination. One or two of the descending sensory branches of the cervical plexus incline medially but they are in the fat anterior to the prevertebral fascia. The sympathetic trunk and vagus nerve are vertical and nearer the midline of the neck. The long thoracic nerve emerges from among the fibers of the scalenus medius and descends laterally on it.

The nerve to the subclavius frequently contains phrenic fibers that leave this nerve very low in the neck as the so-called principal accessory phrenic nerve and join the main phrenic trunk within the thorax. The nerve to the subclavius usually leaves the anteromesial or mesial surface of the brachial plexus low in the operative field and in a large majority of cases may be identified. If not visible without dissection it may be searched for between the plexus and scalenus anticus by

grasping the epineurium of the fifth cervical root and rotating this with much gentleness. Not infrequent abnormalities in the anatomy of the main and accessory phrenic nerves may greatly complicate the operation.

Flenk, Andre s and Matson, Ralph C. Zur Phrenicotomiefrage. *Beitr. z. klin. u. d. T. he k.* 1925 1: 350-355.  
Gorise, Otto. Die elektrische Blockade des Nervus phrenicus. *Mue chen med. Wchnsch.* 1925 lxxxi 21: 9-1113.



Fig 2 Position of incision in skin crease. Posterior border of sternocleidomastoid accentuated by raising head anterolaterally against resistance. Tick of local anesthetic needle marks anterior end of proposed incision.

OPERATIVE TECHNIQUE OF PHRENIC NERVE INTERRUPTION<sup>1</sup>

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**T**EMPORARY or permanent paralysis of one half of the diaphragm by operation on the phrenic nerve has gained a permanent place in therapeutics. Indications for its use and its distinct limitations have been widely discussed in current journals. This article is limited to presentation of a simple operative technique that has been extensively used in this clinic without any mishap.

Identification of the nerves deep in the base of the neck occasionally is very difficult, especially when their arrangement is abnormal. Study of Figure 1 reveals what vital structures are in jeopardy. In spite of frequently heard statements to the contrary, the operation may prove dangerous and even fatal in either execution or effect. The vagus, long thoracic, and sympathetic nerves by mistake have been cut; the brachial plexus has been wounded; the thoracic duct torn; the dome of the pleura opened; and large arteries and veins wounded. Surely the operation should not be undertaken by anyone untrained in general surgery.

Breakfast is withheld. One half hour before operation adults are given a hypodermic of 0.05 gram of morphine sulphate, but no atropine. The patient lies on his side on the operating table, with a pillow beneath the head to keep the neck in line with the trunk. When the patient lies on his back the omohyoid muscle assumes a higher position and makes approach to the phrenic nerve above the muscle relatively difficult. Approach below rather than above the muscle requires a deeper dissection and in closer proximity to the thoracic duct and other structures desirable to avoid.

Stainless Harrington's solution or alcohol is painted upon the skin which was cleaned and, if necessary, shaved the previous evening. Drapes are placed so as to leave exposed only the lower few inches of the sternocleidomastoid muscle and posterior cervical triangle. The surgeon stands behind the patient; the assistant in front.

The anterior end of the proposed incision begins at the posterior border of the sternocleidomastoid muscle where it is crossed by that oblique skin crease which appears or is made apparent by flexing the head laterally from 2 to 4 centimeters above the clavicle. It is important that the furrow posterior to the sternal tendon of the sternocleidomastoid be not mistaken for the far less

evident furrow behind the clavicular fibers. The latter may be made apparent by having the patient raise his head anterolaterally against the resistance of a nurse's hand placed on his forehead as illustrated in Figure 2. A fine hypodermic needle is made to pierce the skin at the anterior end of the proposed incision and this one puncture mark serves to identify the point after the muscle is relaxed and the local anesthetic has been injected. From 10 to 15 cubic centimeters of 1½ per cent of procaine is injected intradermally and into the superficial tissues.

The incision need not be longer than 2 centimeters in the case of thin persons; in others rarely more than 4 centimeters. The skin, subcutaneous fat and platysma muscle are opened in this order. Small towels are sewed to the subcutaneous tissue to exclude skin organisms from the wound. Beneath the platysma and the superficial layer of the deep cervical fascia the external jugular vein sometimes crosses the wound and may be either divided or retracted. Next in depth the superficial layer of the deep cervical fascia is incised. Beneath it is an always thick layer of fat in which one or two descending sensory branches of the cervical plexus are usually met; these are directly infiltrated with procaine and retracted, or perhaps divided. In this fat may also be met lymph nodes and the large superficial and transverse cervical arteries and veins. On their account it is well to divide this fat bluntly with scissors. Satisfactory retractors are pictured in Figure 7. The mesial retractor may so flatten and empty an abnormally posteriorly placed internal jugular vein that it may appear as a strip of fascia and might innocently be cut.

Deep to the fat is the rather dense prevertebral fascia which immediately covers the scalene muscles, the phrenic nerve and brachial plexus. These structures are only indistinctly visible through this fascia (Fig. 4) which must be incised in order certainly to identify them.

The brachial plexus, which term is used loosely to designate the anterior primary divisions of the cervical nerves, is the best guide to the phrenic nerve. The plexus passes inferiorly and slightly laterally between the scalenus anticus and medius muscles. Only rarely is it necessary to separate these muscles in order to see it. Mesial to it and posterior to the sternocleidomastoid is the scalenus anticus at the inner edge of which may be

<sup>1</sup>From the Department of Surgery, University of Michigan Medical School.

surroundings as far inferiorly as safely possible in order to rupture sympathetic filaments from the suprapleural sympathetic plexus that may have some motor function. Obviously, if more than one accessory phrenic trunk exists, all must be severed. In one case I found five phrenic trunks, in another four.

Temporary total paralysis of the diaphragm which persists 3 or 4 months, is best obtained by thoroughly crushing the main phrenic trunk with a hæmostat and either crushing or excising a portion of the accessory phrenic (Fig. 6).

Knowledge of whether or not total diaphragmatic paralysis has been accomplished is most surely obtained through the fluoroscope. Total paralysis leaves the paralyzed hemidiaphragm in position of full expiration and, as the patient sniffs, the paralyzed half rises and the unparalyzed half descends. This upward movement on sniffing or deep inspiration is paradoxical respiratory movement. If a fluoroscope be not available in the operating room, percussion of the height of the hemidiaphragm and of its ability to move on deep respiration offers a usually accurate test of the completeness of the operation.

In closing the wound the only sutures used are two or three of catgut in the platysma and one continuous intracuticular mattress suture of 'dermal' or horsehair (Fig. 7). If knots are tied

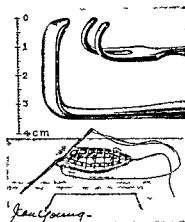


FIG. 7 The longer retractor is useful to obtain extensive exposure deep in wound. Intracuticular suture enters and emerges at very edge of cut skin. Suture ends have been pulled to close wound and knots tied at a distance from skin.

at the ends of the cutaneous suture they should be at least 1 centimeter from the skin to prevent their being buried as a result of postoperative swelling of the wound. No drainage is used. The intracuticular suture is removed in 5 days. Lymphoedema may keep the wound indurated for several weeks. The scar after the operation is usually inconspicuous.

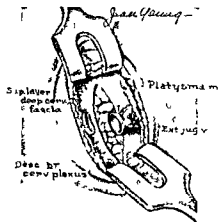


Fig. 3 Superficial tissues divided. Exposure of descending sensory branches of cervical plexus in thick fat layer

Crushing or excising a portion of only the main phrenic trunk cannot be relied upon to cause total hemidiaphragmatic paralysis. The accessory phrenic nerve must also be treated. Permanent total paralysis or phrenicectomy may be obtained in either of two ways:

1. *Excision or evulsion.* Excision or evulsion of the main phrenic trunk at the same time ruptures any accessory nerve fibers that may have entered the main trunk. This is first directly infiltrated with procaine and divided proximal to a haemostat or better Oscar Proctor's special forceps (Fig. 5). Then by steady, not jerky, traction the nerve is very slowly rolled around the instrument care

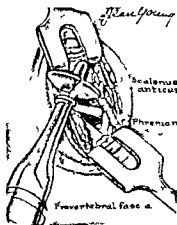


Fig. 5 Prevertebral fascia incised. Main phrenic nerve divided and distal portion being evulsed with Proctor's forceps

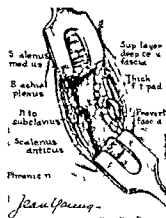


Fig. 4 Exposure of prevertebral fascia with underlying structures indistinctly visible

being taken that the nerve be kept clean from clinging connective tissue that might, if evulsed, cause rupture of the pericardiophrenic vessels. If evulsing the nerve causes severe pain in the neck, shoulder, thorax, or abdomen several moments of gas analgesia should be given. If not fewer than 12 centimeters of the nerve are evulsed before rupture, it is reasonably certain that the accessory phrenic has been disconnected from the diaphragm.

2. *Partial excision of both main and accessory (n. to subclavius) trunks.* After both trunks are directly infiltrated 2 or 3 centimeters of each is excised after the distal ends are freed from their

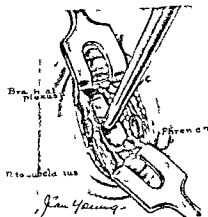


Fig. 6 Temporary phrenic nerve paralysis. Main phrenic trunk has been thoroughly crushed with haemostat and nerve to the subclavius is being crushed

Of 12 cases in which the suture method of anastomosis used was one which gave every evidence of prevention of bleeding from the edges of the anastomosis there was one case in which death occurred from postoperative intravisceral hæmorrhage.

A reasonable working hypothesis would seem to be that if the jaundice could be lessened before the anastomosis is made between the gall bladder and stomach or duodenum, the risk of the operation would be lessened, not alone from the decrease in the tendency to bleeding but also from the lessened chance that precipitation of hepatic or renal insufficiency might occur. To accomplish the decrease in jaundice, external drainage of the gall bladder became a necessity. Realizing that these patients after cholecystostomy lose a tremendous amount of fluid from the tissues of the body, discharged through the biliary tract and in many instances die from this loss of fluid in a comparatively short time I believed that anastomosis between the gall bladder and stomach or duodenum should be made and the operation completed approximately on the twelfth or fourteenth day following cholecystostomy to prevent dehydration toxæmia. This two stage operation has now been used in 3 cases with very satisfactory results.

A No. 30 Pezzar catheter is inserted into the gall bladder through a trocar as one would insert a similar catheter into the distended urinary bladder, the gall bladder having first been exposed through a small abdominal incision made directly over it. This can be done under local infiltration anesthesia of the abdominal wall (Fig. 1). By pulling the Pezzar catheter up so that it fits snugly about the edges of the opening in the gall bladder and fastening it in this position, bleeding is prevented due to compression (Fig. 2). Gradual decompression of the biliary tract as suggested by Crile is done allowing biliary drainage through the tube for 15 minutes every hour until the biliary passages have decompressed themselves.

Twelve or fourteen days later, under local infiltration anesthesia in the abdominal wall with the incision made slightly to the inner side of the preceding one the abdomen is opened, the gall bladder dissected from the abdominal wall and the lighter end of a Murphy button placed in and maintained there by a pursestring suture or by silk. The site of the anastomosis to the stomach or duodenum is dependent on which one of these structures can be best approximated to the gall

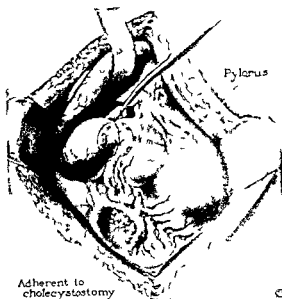


Fig. 3 Cholecystoduodenostomy suture in the anterior wall of the duodenum and gall bladder

bladder without undue tension (Fig. 3). In two or three instances, the duodenum has been used, which I believe is more satisfactory than the stomach. It seems that the anastomosis of the gall bladder to the stomach apparently produces in the first few days following operation interference to motility in the latter to the extent that gastric retention more often occurs than if the duodenum is chosen as the site of the gall bladder anastomosis. A Murphy button type of anastomosis has been chosen, not with any idea of originality, for its use in this anastomosis was suggested and used many years ago by Murphy, Mayo, Mayo-Robson and others, but because in the anastomosis the cut edges of the gall bladder and stomach or duodenum are prevented from bleeding by the compression which exists when the ends of the Murphy button are placed in contact. It has the additional advantage of maintaining an absolutely constant lumen to the anastomosis regardless of any infection, swelling or œdema which may take place about it. In both respects I believe it has an advantage over the suture method. In one or two instances following a suture type of cholecystenterostomy I have felt certain that the cause of unusually severe postoperative reaction was due to swelling or œdema occurring at the point of anastomosis producing incomplete biliary obstruction which, in such jaundiced patients is nearly always fatal.

<sup>1</sup> M. F. Leary is to go to July 4, 1920 the two stage method has been used in 4 of 11 cases. King a total of 7 cases in which the results are all 1.

THE ADVANTAGES OF TWO-STAGE CHOLECYSTENTEROSTOMY<sup>1</sup>

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Division of Surgery The Mayo Clinic

THE operation of cholecystenterostomy has justified itself in the relief of obstructive jaundice due to pancreatic obstruction of the common bile duct. If the only result of the operation was relief of jaundice and the termination of the severe and constant itching of which these patients complain so bitterly, it would be worth the operative risk. The risk of the operation is still further justified when one is able to give these patients the benefit of exploration of the biliary passages which not infrequently but unexpectedly reveals a stone in the common duct which has produced jaundice without pain. After cholecystenterostomy if the lesion in the head of the pancreas is an inflammatory one, the patient continues to be well, and if malignant, although he eventually succumbs as a result of the condition, the interval between operation and death becomes a comfortable one.

During the last 4 years, I have performed cholecystenterostomy for the relief of jaundice due to obstruction of the pancreatic portion of the common bile duct on 15 patients. Ten of these are living and free from jaundice and itching. Two patients died at home, 19 and 20 months, respectively, following operation. These patients were free from jaundice and itching and worked until a few weeks before death.

Occasion recently presented itself to re-examine one of these patients on whom cholecystgas-

trostomy was performed January 5, 1925, for the relief of jaundice due to a pancreatic tumor. The postoperative course of this patient was without incident. Successive examinations subsequent to operation and reports from the patient by letter can be summarized as follows: November 12, 1927, the general condition was satisfactory, he had gained 20 pounds in weight and had slight diarrhoea. February 27, 1928, he complained of gas and epigastric pain at night. The stools were more nearly normal than in the previous year and his general condition was satisfactory. In December, 1928, he began to have more severe epigastric pain and an occasional attack of vomiting. He returned for examination January 10, 1929, at which time he showed loss of weight. Roentgenographic examination disclosed an abdominal tumor extrinsic to the lower third of the stomach, compressing it sufficiently to produce gastric stasis. Apparently the patient is on a downward course, yet he has lived nearly 4 years comfortably.

The risk of cholecystgastrostomy has been due to two factors: the tendency to bleeding as a result of severe jaundice and renal and hepatic insufficiency occurring subsequent to operation.

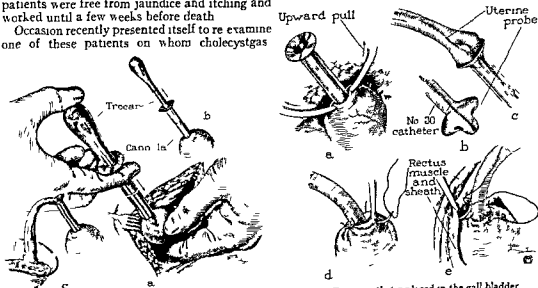


Fig. 1 Puncture of the gall bladder to release bile

Fig. 2 Pezzar catheter placed in the gall bladder

Of 12 cases in which the suture method of anastomosis used was one which gave every evidence of prevention of bleeding from the edges of the anastomosis, there was one case in which death occurred from postoperative intravisceral hemorrhage.

A reasonable working hypothesis would seem to be that if the jaundice could be lessened before the anastomosis is made between the gall bladder and stomach or duodenum, the risk of the operation would be lessened, not alone from the decrease in the tendency to bleeding but also from the lessened chance that precipitation of hepatic or renal insufficiency might occur. To accomplish the decrease in jaundice, external drainage of the gall bladder became a necessity. Realizing that these patients after cholecystostomy lose a tremendous amount of fluid from the tissues of the body, discharged through the biliary tract and in many instances die from this loss of fluid in a comparatively short time I believed that anastomosis between the gall bladder and stomach or duodenum should be made and the operation completed approximately on the twelfth or fourteenth day following cholecystostomy to prevent dehydration toxemia. This two stage operation has now been used in 13 cases with very satisfactory results.

A No. 30 Pezzar catheter is inserted into the gall bladder through a trocar as one would insert a similar catheter into the distended urinary bladder the gall bladder having first been exposed through a small abdominal incision made directly over it. This can be done under local infiltration anesthesia of the abdominal wall (Fig. 2). By pulling the Pezzar catheter up so that it fits snugly about the edges of the opening in the gall bladder and fastening it in this position, bleeding is prevented due to compression (Fig. 2). Gradual decompression of the biliary tract as suggested by Crile is done allowing biliary drainage through the tube for 15 minutes every hour until the biliary passages have decompressed themselves.

Twelve or fourteen days later under local infiltration anesthesia in the abdominal wall with the incision made slightly to the inner side of the preceding one the abdomen is opened, the gall bladder dissected from the abdominal wall and the lighter end of a Murphy button placed in and maintained there by a pursestring suture or by silk. The site of the anastomosis to the stomach or duodenum is dependent on which one of these structures can be best approximated to the gall

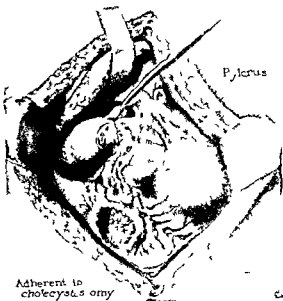


Fig. 3. Cholecystoduodenostomy suture in the anterior wall of the duodenum and gall bladder.

bladder without undue tension (Fig. 3). In two or three instances the duodenum has been used, which I believe is more satisfactory than the stomach. It seems that the anastomosis of the gall bladder to the stomach apparently produces in the first few days following operation interference to motility in the latter to the extent that gastric retention more often occurs than if the duodenum is chosen as the site of the gall bladder anastomosis. A Murphy button type of anastomosis has been chosen, not with any idea of originality for its use in this anastomosis was suggested and used many years ago by Murphy, Mayo, Mayo-Robson and others, but because in the anastomosis the cut edges of the gall bladder and stomach or duodenum are prevented from bleeding by the compression which exists when the ends of the Murphy button are placed in contact. It has the additional advantage of maintaining an absolutely constant lumen to the anastomosis regardless of any infection, swelling or edema which may take place about it. In both respects I believe it has an advantage over the suture method. In one or two instances following a suture type of cholecystenterostomy I have felt certain that the cause of unusually severe postoperative reaction was due to swelling or edema occurring at the point of anastomosis producing incomplete biliary obstruction which, in such jaundiced patients, is nearly always fatal.

<sup>1</sup>From Feb. 3, 1930 to July 4, 1930 the two stage method has been used on 4 abdominal cases making a total of 7 cases in which the results are excellent.



# A MANOMETRIC METHOD FOR THE DETERMINATION OF THE LEVEL OF A SPINAL SUBARACHNOID SPACE BLOCK<sup>1</sup>

LOYAL DAVIS M.D. F.A.C.S. AND LEWIS J. POLLOCK M.D. CHICAGO

IT is a familiar fact that if water is poured into a number of connected tubes, the surfaces of the liquid in the various tubes will lie in the same horizontal plane. If an additional amount of water is poured into one of these tubes, the fluid level will rise the same distance in each tube. The successive additions of similar amounts of water will be followed by a rise in fluid level of the same distance. However, if one of the tubes is sealed at any given level the introduction of any amount of water will be followed by an increased rise of the fluid level in the two unsealed tubes. This obvious fact can be utilized in the determination of the level of a complete block in the spinal subarachnoid space.

If one of three rigid tubes is sealed before any fluid is introduced, the liquid will rise then only in the two unobstructed tubes. This follows because the pressure against which the fluid has to rise is far less than in the sealed tube where the air must be compressed. However, if the tubes are filled with liquid and two of them are sealed at higher levels than the third and then, if the fluid is removed and reintroduced, the failure of filling may be obviated. Similarly, if the third tube is not a rigid tube the fluid will rise in it as well as in the remaining two. Weed<sup>2</sup> has shown that the spinal dural sac is not a rigid tube but can collapse inwardly. Therefore, it lends itself to the study of the above hydrodynamic principle.

With these facts in mind a model was constructed (Fig. 1). A glass manometer tube calibrated in centimeters was attached to one of the arms of a Y glass tube by means of one inch of rubber tubing. The other arm was attached to a soft rubber slip cover for a Kollmann urethral dilator. To the straight arm, a T tube was attached by one inch of rubber tubing after the interposition of a valve which permitted a flow of fluid only in the direction of the manometer. A long rubber tubing was attached to one of the arms of this T tube. Its free end was submerged in a bowl of water. In the course of this piece of tubing a valve was placed which allowed the fluid to pass only from the bowl to the manometer. To the other branch a one cubic centimeter syringe was attached. It will be seen that successive injections of 1 cubic centimeter of water could be

made continuously by aspirating the fluid from the bowl and forcing it into the manometer and slip cover at the same time. After the rubber slip cover was stripped of air, the system was filled with water and all bubbles of air removed. The water was allowed to flow out until a level in the manometer was reached which was designated as zero. A ligature was applied around the rubber slip cover and water injected in amounts of 1 cubic centimeter at a time. At the end of each injection, the height of the fluid level was read off on the manometer. Before the level of the ligature was reached, each injection of 1 cubic centimeter of water was followed by a rise of level of the water in the manometer which was fairly constant. When the level of the ligature was reached the next injection of 1 cubic centimeter of water would be followed by a rise of the level of the water in the manometer which was critically greater in height. This was tried repeatedly at different levels upon a considerable number of occasions. The readings may be illustrated by the following figures. The figures in the upper line represent the manometer before the height of each successive rise, and the figures in the lower line represent the amount of each rise.

4.65	4.5	4.35	4.2	4.05	3.9	3.8	3.2	2.65	0
0	.15	.15	.15	.15	.15	.15	.10	.6	.65

The critical rise in this instance was between 3.8 and 3.2 centimeters. This figure was then corrected to a more accurate localization by bracketing it. Starting at 4.2 the figures were as follows:

4.0	4.05	3.9	3.65	3.2	6	2.0	1.4	8
0	.15	.15	.25	.45	6	6	.6	.6

The level of the ligature was at 3.65 centimeters, and the experiment accurately localized it. In this experiment a burette calibrated in tenths of a cubic centimeter by volume was used. Each  $\frac{1}{10}$  of a cubic centimeter was equal to 1 centimeter in distance. The same experiment was repeated upon a cadaver in which a ligature was placed about the spinal dura mater at the level of the fourth dorsal vertebra. The results were identical.

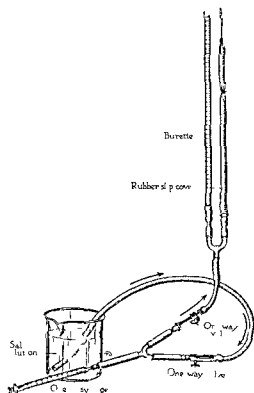
An opportunity to use the method presented itself to us in 2 cases. In 1 case, in which a compression was localized at the level of the spine of

<sup>1</sup>Weed Lewis H. Some limitation of the Mero-Kellie hypothesis. Arch Surg 1929 xvi, 1049.

<sup>2</sup>From the Departments of Surgery and Nervous and Mental Diseases and the Laboratory of Surgical Research, Northwestern University Medical School.

the third cervical vertebra, an operation has not been performed. When the patient consents to an operation the result will be published in a further communication. The other patient, a female aged 36 presented the picture of a slowly progressive brachial and crural paraplegia with a poorly defined sensory level but with a motor level which pointed to a localization of the lesion at the fourth cervical segment. A complete spinal subarachnoid block was demonstrated by manometric study and this method of localization was applied. After all the cerebrospinal fluid had been withdrawn from below the lesion successive injections of 5 cubic centimeters of normal saline solution at body temperature were made. There was a critical rise in the fluid level of the manometer at a height which corresponded to the spine of the third cervical vertebra. One of us performed a laminectomy and removed a meningeal fibroblastoma intradurally located beneath the lamina of the fourth cervical vertebra.

Although we believe that the usual sign of the level of compression is indicated by a sharp rise in the fluid level in the manometer after the level of the compression has been reached in the case alluded to, which has not been operated upon a reading was obtained which indicated that under certain conditions the dural sac continues to be filled out after the level of compression is reached and a plateau appears in the graph of figures immediately below this level. For example, after successive injections of 5 cubic centimeters of normal saline solution at body temperature a rise in the manometer of 3.5 cubic centimeters was seen then a succession of four readings of 5 after which there was a rise to 8. The level opposite the figure 5 corresponded accurately to the level determined by clinical examination.



The method would lend itself equally well to tumors of the cauda equina. In this case it would be necessary to invert the table so that the patient is supported with his head down. Sufficient cerebrospinal fluid should be removed to allow the level of cerebrospinal fluid in the dural sac to be well below the needle. Then the same technique can be applied.

SEPARATION OF THE SYMPHYSIS PUBIS<sup>1</sup>

JOSEPH G. WISNER, M.D. AND LEO MAYFR, M.D. NEW YORK

**S**EPARATIONS of the symphysis pubis fall etiologically into two groups. In the first the separation is caused by some severe external trauma, such as the fall of a heavy weight against the abdomen. Such cases are usually complicated by extensive visceral injuries and the percentage of mortality due to these complications is so high as to render the correction of the bony separation a subject for theory rather than for practice. This group of cases is unquestionably small and relatively unimportant. The second group is limited to those occurring during parturition. In these the pubic bones are forced apart by the descent of the fetal head either with or without the complicating action of forceps. Previous statistical evidence would seem to indicate that this second group is also extremely rare. Thus Tuley reports only one case in 30,000 deliveries, Morgan 4 cases in 80,000 deliveries at the Lying in Hospital. At the Sloan Maternity Hospital only 3 were noted in 4,500 patients. Kayser found only 3 in 94,000 cases.

Despite these figures we have ourselves within a year been able to observe 5 postpartum cases and have without conducting an extensive inquiry, been informed of 6 additional cases. We have therefore gained the impression that separations of the symphysis pubis occurring during parturition are not as rare as have been supposed and that the apparent rarity of the lesion is due chiefly to lack of recognition. We are writing this paper first, to emphasize the comparative frequency of separations of the symphysis pubis as a postpartum complication second to facilitate diagnosis by description of the typical syndrome, third to explain by cadaver studies the mechanics of the lesion fourth, to describe an effective simple method of treatment.

## ANATOMY AND PHYSIOLOGY OF THE SYMPHYSIS PUBIS

The articulation between the pubic bones is an amphiarthrodial joint formed by the junction of two oval articular surfaces. These bones are held together by four strong ligaments: the anterior pubic (most powerful), the posterior pubic, the superior and inferior (arcuate). It is maintained by some anatomists that normally there may be slight up and down motion at this joint but the authors in their study both of the cadaver and of the living have never been able to demonstrate

the least motion in the normal articulation. During pregnancy, however, there occurs a marked relaxation of all the pelvic ligaments which may permit a separation of the symphysis even before delivery (Lynch). Ralph Beach reports a case in which this separation amounted to four fingers. This relaxation unquestionably predisposes to the separation caused by the descent of the fetus.

## MECHANICS OF THE SEPARATION

The cause of the separation is unquestionably the distending effect of the fetal head acting against the pelvic ring which gives at its weakest spot. Frequently forceps are a potent factor (Eastment, Havaje Weiz). What the exact pathology is we still do not know since no case has been adequately autopsied. In one instance reported by Boislaniere and in another by Mac Pherson a distinct crack was audible during delivery, thus suggesting an actual tear. We have however, been unable to find similar reports and it certainly did not occur in any of the cases studied by us. It would therefore, seem to be an exceptional occurrence. There is certainly no X-ray evidence to bear out the contention of some authors that the rupture takes place through the cartilaginous attachment to the pubic bone on one side or the other. In the absence of exact pathological data we can only hazard the guess based upon our cadaver studies, Lynch's researches and the clinical data that the separation is usually due to a stretching of the ligaments rather than to a complete rupture.

When the symphysis pubis separates there is bound to be a separation of the anterior portion of the sacro iliac joint either of one or both sides. This complicating lesion of the sacro iliac joint is usually unilateral as evidenced by the X-ray examination and involves so far as we can observe chiefly the anterior sacro iliac ligaments. To study the mechanism of its production we removed a pelvis from a female cadaver with all the ligaments intact. The femoral heads were left in the sockets and the shafts were sawed off 3 inches below the hip joints. Roentgenograms were then taken from above downward and also in the anteroposterior plane (Fig. 1). After the pubic ring was cut through at the symphysis pubis the pubic bones were pried apart a distance of 4 centimeters. As this was being done the anterior sacro iliac ligaments were observed to

<sup>1</sup>From the Orthopedic Service of Dr. Leo Mayfr, Hospital for Joint Diseases, New York City.



Fig. 1 Anteroposterior roentgenographic view of pelvis which was removed from female cadaver



Fig. 2 Anteroposterior X-ray view of pelvis removed from female cadaver after the symphysis pubis had been pried open. Note the separation of the sacro iliac joints

give way and the anterior portion of the right sacro-iliac joint gaped open a distance of about  $\frac{3}{8}$  inch, the left about  $\frac{1}{4}$  inch (Fig. 2). The therapeutic significance of these anatomical observations is obvious and will be emphasized later under the discussion of therapy.

#### CLINICAL PICTURE

All of our patients gave a similar history which varied in degree rather than in kind. Following delivery they felt pain in the pubic region and in the lower back, in some instances extending down the thigh. Some had difficulty in moving the legs even when in bed. On getting up at the end of the puerperium they experienced more pain and found that they had difficulty in walking. Some felt a distinct separation of the pubic bones with each step.

The objective examination was so typical that after the first case had been studied the others were diagnosed without roentgenogram. The gait is a peculiar waddle as characteristic of this lesion as is the gait of a bilateral dislocation of the hips. Once seen, it in itself suffices to make the diagnosis. There is in addition definite tenderness in the region of the symphysis pubis, and one or more fingers can be inserted between the pubic bones. There may be tenderness of one or the other sacro-iliac joint. The peculiar feature of the sacro-iliac involvement is the absence of spasm of the hamstring muscles. In this respect this type of injury of the sacro-iliac joint differs from almost all other sacro-iliac lesions which we have observed. The patient may have difficulty in raising the heel from the bed and there may be weakness in the execution of other motions of one or both hips. When the patient is asked to stand

on one leg, the pelvis usually sinks slightly toward the opposite side (positive Trendelenburg sign). This sign is more marked when the patient stands on the side complicated by the sacro-iliac lesion. It is frequently possible to demonstrate motion at the symphysis pubis by abducting the legs or alternately moving them up and down. The roentgenogram confirms the separation of the symphysis pubis and also shows a separation of the anterior portion of one or both sacro-iliac joints.

#### ANALYSIS OF THE LIMP

On first thought the limp would seem to be due entirely to the instability of the pubic arch. Unquestionably this is the chief factor but there is another the significance of which is not as obvious. To appreciate this second factor, the reader is asked to compare Figure 3, a roentgenogram of a pelvis removed from a female cadaver viewed from above downward with Figure 4, a similar roentgenogram of the same pelvis after the pubic bones have been pried apart a distance of 4 centimeters. It is evident that owing to this separation there is a marked deviation in the relationship of the hip joints from the normal. This change is brought out more clearly by drawing the lines  $I' A'$  and  $A A'$  joining the anterior margins of the acetabula  $B B$  and  $B B$  joining the anterior border of the pubic bones. The backward displacement of the hip joints is evidenced graphically by comparing the line  $A C$  in Figure 4 with  $A' C'$  in Figure 3. These lines represent the vertical distance between the anterior border of the pubic bones and the anterior border of the acetabula. This backward displacement and change in the direction of the hip joint is illustrated even more clearly by a diagrammatic

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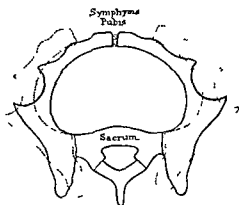


Fig 5 Diagrammatic cross sections of the pelvis indicating the normal relationships and the pathological (dotted lines) after separation of the symphysis pubis. The diagram illustrates the posterior displacement of the acetabula after separation of the symphysis pubis and the change in the direction of the acetabula which face directly outward instead of forward and outward.

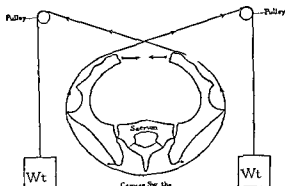


Fig 7 Diagram illustrating the lines of force in the author's method of correcting separation of the symphysis pubis. Note that the direction of the corrective force is such as to close the sacro-iliac joints as well as the symphysis pubis.

after parturition, 10 days were sufficient for correction. In our first patient who was seen 6 months after delivery 3 weeks were required before the result was satisfactory although after 1 week there was a definite diminution in the separation. In these long standing cases the separation is likely to recur when the patient gets out of bed. To prevent this we equipped our patients with a specially constructed corset in which a strong strap running beneath the anterior superior spine enabled them to apply a similar compressive force even when walking about. This sufficed for all the cases that came under our care but it would seem to us highly probable that in patients in whom the lesion has existed for a year or longer this type of support would be ineffectual and operative measures would be necessary. When confronted with this type of case we shall have no hesitancy in performing a bone graft operation of the type suggested by Albee, after the separation has been overcome by the method of circular compression.

The roentgenograms taken during the course of treatment showed that in cases seen comparatively soon after parturition (2 or 3 weeks) a perfect anatomical as well as functional result could be secured. In cases of long standing, good function resulted but a slight separation of the symphysis persisted (1.5 centimeters being the maximum). To determine how far this exceeded the normal we measured the roentgenograms of 20 normal female pelvis and found a considerable variation in the separation of the pubic bones at the symphysis. This ranged from 0.3 centimeters

to 0.9 centimeters. In our review of the literature we also found that Ralph Beach reported a persistent separation of 3 centimeters without symptoms. These facts indicate that a perfect anatomical correction is not necessary and that the roentgenogram, though important, is not to be considered the final criterion of cure. This would seem to be rather the restoration of the normal stability of the pubic arch and the realignment of the sacro-iliac joints. In this conclusion we are



Fig. 6 Photograph illustrating the author's method of correcting separation of the symphysis pubis. The broad swathe passes completely about the patient's body and crossing in front exerts strong corrective pressure by means of the weights attached to cords running over the pulleys attached to the wooden uprights on each side of the bed.

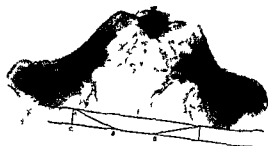


Fig 3 Roentgenogram of pelvis removed from female cadaver taken from above downward showing the normal plane of the acetabula

cross section of the pelvis at the level of the symphysis pubis (Fig 5). The dotted lines indicate the pelvic outline after separation of the symphysis pubis. It is quite evident that the acetabula, subsequent to separation of the pubic bones instead of facing forward and outward, face directly outward thus causing an external rotation of the thigh and a derangement in the mechanical action of the muscles running between the pelvis and the femur.

#### THE RAPY

It is possible that were the lesion recognized immediately after parturition, firm strapping with adhesive plaster running from the anterior spine on one side to the anterior superior spine on the other, might overcome the separation of the pubic bones. The cases, however, which came to our attention had with one exception, all been up and about for some time and traction by means of adhesive plaster held out little prospect of reducing the separation. Operative procedures have already been described (bone graft suggested by Albee wiring suggested by Allen).

It seemed to us advisable to try non operative measures before adopting either of these procedures. Our study of the pathology of the lesion indicated that there were three important mechanical derangements: (a)—separation of the pubic bones, (b) separation of the anterior portion of the sacro iliac joint of one or both sides, (c) a posterior displacement of the acetabulum and a consequent change in the plane of the hip joints which faced almost directly laterally instead of anterolaterally. The treatment therefore had to correct all three pathological changes. The arc of correction ought to correspond so far as possible with the arc of the pathological separation. The device illustrated in Figure 6 meets these requirements.

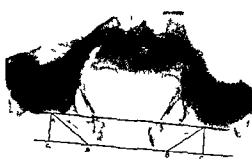


Fig 4 Roentgenogram of pelvis removed from female cadaver taken from above downward after the pubic bones had been separated a distance of 4 centimeters. The lines 1 A and 4' 4' have been drawn parallel to the anterior lip of the acetabula. The lines B B and B B have been drawn connecting the pines of the pubic bones. The vertical distance between the lines 4 C and 4' C has been markedly increased by the separation of the symphysis pubis. This indicates the posterior displacement of the acetabula.

By the application of a powerful circular compression to the pelvis the pubic bones are brought together, the gaping sacro iliac joints are closed and the acetabula are restored to their normal plane. The mechanism of the correction is shown more clearly in the diagram, Figure 7.

The patient's back is first firmly strapped in the region of the sacro iliac joints so as to afford support to the posterior sacro iliac ligaments and she is placed in bed on her back. A canvas swathe 6 to 8 inches in width (depending upon the size of the patient) and long enough completely to envelop the pelvis and extend 8 or 10 inches beyond the body is made to encircle the patient from behind forward (Fig 6). At each end of the swathe is inserted a wooden spreader to prevent wrinkling. To this spreader is attached a rope which runs over a pulley attached to a wooden frame on each side of the bed. To this rope a weight is attached. Beginning with 5 pounds this weight may rapidly be increased to as much as 25 pounds on each side. The swathe exerts a continuous compressive force, working in an arc corresponding to that of the pathological separation, gradually bringing the pubic bones into normal relationship and reducing the separation of the anterior portion of the sacro iliac joints. The process if properly supervised is painless. The duration of treatment varies depending upon the duration and the degree of the separation of the symphysis pubis. In a mild case seen 3 weeks



Fig 10 Anteroposterior view of pelvis of patient 1 six months after discharge from hospital. Patient was entirely without symptoms though the X-ray picture still shows a separation of 1 centimeter.

Examination showed that there was a slight list to the left in an attempt to keep the weight off of the right side. When patient was asked to stand on the right leg the left side of the pelvis tilted downward a trifle—positive Trendelenburg sign—(Fig 11). The muscles of the right hip were decidedly weak. There was no hamstring spasm. The pubic bones were separated enough to admit one finger and there was marked tenderness in the space between them. There was a slight tenderness of the right sacroiliac joint. Roentgenogram showed a separation of 3 centimeters and slight separation of both sacroiliac joints.

The patient was admitted to the hospital December 17, 1927. The pelvic compression device was applied and the separation gradually reduced. She was discharged February 22, 1928, without limp or pain. She has reported regularly at the clinic. She is able to walk without pain but still has to wear the corset with webbing straps.

**CASE 3** (courtesy of Dr H. Sonnenschein). Mrs. B. H. aged 33 years. Six weeks before admission she was delivered of her second child. After severe labor forceps had to be applied. She was admitted to the hospital January 27, 1927, complaining of difficulty in walking which became evident 10 days postpartum when she first got out of bed. Three weeks later she experienced a sudden sensation of something stretching or giving way and fell in a faint. Since that time she has been unable to walk. The patient has some pain even when lying quiet.

Examination shows a gap between the symphysis pubis admitting two fingers; the space is quite tender. There is tenderness of both sacroiliac joints. The patient is unable to walk. The compression device was applied and kept on until February 20 (3 weeks). At the time of discharge the gap between the pubic bones had been markedly reduced. The finger could not be inserted between the pubic bones. The patient was able to walk but with a slight waddle in her gait. She was equipped with a special corset and after a few months the waddle entirely disappeared. The patient's present condition is normal.

**CASE 4** (courtesy of Dr. Both). Mrs. B. aged 34 years. She was delivered February 14, 1923, at the St. Joseph's Hospital, 140 Rockaway, of her third child. It was a breech presentation; a manual delivery and extraction was done without any special difficulty. On the fourth day postpartum she complained of severe pain in the vagina. On the tenth day when allowed out of bed she was unable to walk because of pain. Vaginal examination at this time showed nothing abnormal. At about this time Dr. Both

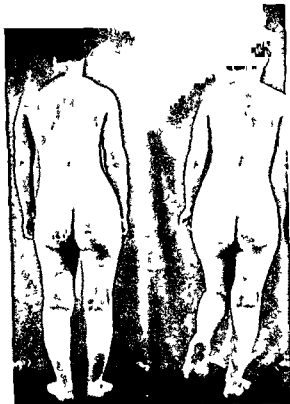


Fig 11 Photograph of patient 2 illustrating the drooping of the pelvis on the left side when the patient brought all her weight to bear on the right hip (positive Trendelenburg sign).

happened to hear of the cases of separation of the symphysis pubis being treated at the Hospital for Joint Diseases and requested a consultation, suspecting that his patient might be suffering from this condition. She was seen March 10, 3½ weeks after delivery.

Examination showed a separation of almost two fingers between the pubic bones. There was marked tenderness in this region and also of the left sacroiliac joint. The patient could stand for a few minutes but was unable to walk. X-ray picture showed 2 centimeters separation of the symphysis pubis. The compression device was applied 10 pounds on each side. This was increased to 20 pounds. After 10 days the separation had been overcome and the patient left the hospital. She continued treatment at home for another 10 days. At the expiration of this time she was allowed up and about wearing a sacroiliac belt. When last seen 6 months later she was entirely without symptoms.

**CASE 5** Mrs. H. G. aged 24 years. This patient was first seen February 3, 1928. She gave a history of a congenital hip dislocation. Eighteen months before after delivery of her first child, she had had great difficulty turning in bed and when allowed to stand had had difficulty in walking. The limp which she had had since childhood developed into a waddling gait. She was given no treatment at the time and according to the records of the hospital where she was confined, no abnormality was noted. One





Fig 8 Anteroposterior view of patient 1 at time of admission to hospital showing separation of the symphysis pubis of 4 centimeters.



Fig 9 Roentgenogram of patient 1 taken in bed after removal of the corrective traction

strengthened by our study of Case 6, in which the symptoms were evidently due to the weakness of the pubic ligaments without demonstrable separation of the pubic bones.

#### CASE REPORTS

**CASE 1.** Mrs. R. R. aged 34 years. Past history revealed nothing of importance. Pregnancy had been normal and delivery occurred November 30, 1922, forceps being applied after labor had lasted 4 days. Although the head was very large delivery was successfully accomplished. As soon as the patient reacted she complained of pain in the pubic region, in the right hip and in the right sacroiliac joint and inability to move her legs. No lacerations in the vaginal wall were noted. There was bladder retention and she was catheterized for 6 days. A diagnosis of separation of the symphysis pubis was made. The patient was treated with adhesive strapping applied over the anterior lower half of the abdomen and kept in bed 3 weeks. On rising she had pain and walked with a marked limp. She was then admitted to a hospital where roentgenograms showed a separation of the symphysis pubis of 4.5 centimeters. Treatment consisted of adhesive strapping encircling the lower half of the abdomen and after 5 weeks she was discharged wearing a belt. The original separation was slightly diminished but the patient considered her condition unimproved.

On May 11, 1926, 6 months after parturition the patient consulted us. She complained chiefly of pain in the region of the pubis, the right hip and the right lower back and of an annoying sensation of the bones moving in the lower part of the abdomen when she walked.

**Physical examination.** When she stood an increase in the lumbar lordosis was noted. There was slight tenderness between the two pubic bones and a space admitting two fingers. There was no tenderness about the right hip and none over the sacroiliac joints. The patient could not raise her right heel from the table without assistance. When the legs were abducted motion of the pubic bones at the symphysis pubis could be detected. The patient walked with the peculiar waddle characteristic of the lesion. There was no shortening of the lower extremities; there was no hamstring spasm. Vaginal examination disclosed

only the separation at the symphysis pubis. The roentgenogram showed a separation of 4.5 centimeters (Fig. 9).

The mechanical device already described was then applied (Fig. 6). At first 10 pounds were hung on each side and later the weights were increased to 15 pounds. More than this the patient could not tolerate. Traction was continuous night and day except at meal time when the patient was allowed to sit up in bed.

Within one week a definite diminution in the separation was noted. After 2 weeks of treatment the space was apparently closed. When the patient sat up however 0.5 centimeters separation could be felt (Fig. 9). After 4 weeks the patient was allowed to stand up; then a separation of 1.5 centimeters was evident but without any pain or disability. After an attempt to use a plaster of Paris corset a special corset reinforced by canvas straps was applied and with this the patient was allowed to leave the hospital. She was entirely cured of her pain; she walked without a limp or waddle. She had complete power at the right hip. There was no longer an abnormal mobility at the symphysis. No space was palpable between the pubic bones but the roentgenogram still showed a separation of 1.5 centimeters (Fig. 10). The gaping of the sacroiliac joint had been completely reduced.

**CASE 2.** Mrs. R. C. aged 29 years was delivered of a dead baby weighing 9 pounds October 13, 1927. Forceps had to be applied. Post partum there was severe bleeding and blood transfusion had to be done. Patient had severe pain in the lower back and right hip; she could not turn because of pain and weakness of the leg, and so lay on her back for weeks. She could not move either leg. If the legs were abducted patient screamed and the nurse had to bring them together. She had to be catheterized for one week. After 3 weeks some power in the legs returned. No diagnosis was made until this patient came to the dispensary of the Hospital for Joint Diseases, December 8, 1927, months after the onset of her trouble. Then she complained of pain in the right lower back, right hip and down the right thigh and calf. She walked with a decided tilt to the right but her gait was not of the typical waddling type. It was rather suggestive of weakness about the right hip joint. She could walk about for only a short time. There was no pain when she remained quiet in bed but turning over was uncomfortable.

# THE HYPERTROPHY OF FASCIA AND ITS USE IN THE REPAIR OF LARGE SCROTAL HERNIÆ<sup>1</sup>

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THE literature on the use of fascia in the repair of inguinal herniæ is voluminous. However, there are almost no pertinent observations on the hypertrophy of the fascial layers which develops to such a striking degree in large scrotal herniæ of 5 to 10 years' duration. Halsted in 1903 called attention to the use of the cremaster and remarked 'It is a step of the operation to which one is irresistibly drawn in some cases by the great strength of the cremaster and the firmness of its attachment to Poupart's ligament'. He emphasized the hypertrophy of the cremaster muscle saying little about the cremaster fascia and nothing about the hypertrophy of other fascial layers. The purpose of this paper is (1) to call attention to the hypertrophy of the fascial layers occurring in large scrotal herniæ of relatively long duration and (2) to present a method of utilizing this fascia in the repair of this difficult class of herniæ.

## ABNORMAL ANATOMY

For the purpose of brevity the term, scrotal hernia will be used hereafter not in the ordinary sense of a simple hernia within the scrotum but rather to designate an inguinal hernia which has been in the scrotum for a length of time sufficient to result in a marked hypertrophy of the fascial layers. It is impossible to state arbitrarily how long a hernia must have been in the scrotum to result in this hypertrophy because it is the outgrowth of the adaptation of tissue to the new demands. Therefore, it is obvious that the degree of hypertrophy of fascia will depend among other things upon the force required to restrain the further progress of the hernia which is in turn determined by the size of the hernial ring, the intra abdominal pressure (occupation, coughing, etc.) and whether the individual has worn a truss or suspensory as well as upon the time element.

In order to appreciate the possibilities of utilizing these hypertrophied fascial layers it is desirable briefly to review the salient points of their embryological development. As the testes descend into the scrotum they carry with them the fascial planes through which they pass and a few fibers of the internal oblique muscle.

The intercolumnar fascia (external spermatic fascia) lies immediately beneath the dartos. It is the continuation of the deep fascia which overlies the external oblique muscle and is adherent to the aponeurosis of that muscle. It is carried downward with the descent of the testicle, and is normally a thin filmy layer which can be demonstrated by injecting fluid beneath the aponeurosis of the external oblique when the fascia covering the cord becomes distended. The hypertrophy of this translucent layer of fascia is brought out to a striking degree in scrotal herniæ (Figs. 1 and 8).



Fig. 1. Dissection of hypertrophied fascial layers. EOb, External oblique; IOB, internal oblique; TrM, transversalis muscle; TrF, transversalis fascia; ER, external ring; IF, intercolumnar fascia; CMF, cremaster muscle and fascia; InfF, infundibuliform fascia; P, peritoneal sac.

<sup>1</sup> From the Surgical Clinic of the Peter Bent Brigham Hospital and the Department of Surgery, School of Medicine, Yale University.

year later she was delivered of a second child (July 20 1927) the delivery was spontaneous and the child quite normal. Owing to pain and difficulty in walking an X ray picture was taken which showed a separation of the symphysis pubis of almost 1 3 inches and a widening of the right sacro-iliac joint. She was given a fixation corset which however helped her very little. When first examined by us the patient showed a waddling gait peculiar to separation of the symphysis pubis. The symphysis pubis admitted 3 fingers easily. There was marked tenderness in this region. The patient was admitted to the hospital February 16. The compression device was applied at first with 10 pounds on each side gradually increasing to 25 pounds. She was discharged March 26. An X ray picture showed that the separation of the pubic bones had been reduced to 1 5 centimeters. On palpation it was impossible to insert the finger between the pubic bones. The patient was equipped with a special belt which she has been using ever since.

CASE 6 Mrs M E B aged 37 years is reported not as a separation of the symphysis pubis but as a closely related condition which presented features peculiarly like those of a separation. The symptoms dated back 7 years to delivery of her first and only child. The patient complained of difficulty in walking and particularly in going up stairs. Because of this the patient had consulted numerous physicians but had been given no relief. The symptoms had been gradually progressing until the patient had great difficulty in getting about.

Examination showed that the patient walked with a waddle suggestive of that of a separation of the symphysis pubis but differing from it slightly. At the symphysis pubis there was a slight apparent sag between the bones and very marked tenderness. There was also marked tenderness of the right inferior sacro-iliac ligament, somewhat less of the left. There was muscular weakness of all the muscles about the right hip. The reflexes were normal. X ray picture showed no separation but a definite abnormality of the right pubic spine strongly suggestive of an old fracture.

In view of the close resemblance of the symptoms to those of a sacro-iliac separation it was decided to try a similar line of treatment. It was argued that even though there was no separation of the pubic bones there was a weakness of the pubic ligaments and of the sacro-iliac ligaments. The patient was accordingly placed in the typical traction device after adhesive plaster strapping had been applied to the sacro-iliac region. She was admitted to the hospital January 17 1927, discharged February 22 1927. The tenderness in the pubic region gradually disappeared also that of the sacro-iliac ligaments. After 3 weeks under traction the patient was able to lift the right heel from the bed something which she had been unable to do since the childbirth 7 years before. She was discharged wearing a sacro-iliac belt and a firm supporting corset. She maintained the traction treatment at home most of the time for the next 2 months. Gradually she was allowed more and more time out of bed. Six months later traction was discontinued except during the menstrual period when the patient found that if the traction were not applied she had a slight return of the original symptoms. At the time of writing the patient is normal.

#### SUMMARY

The authors' conclusions from a study of five typical cases of postpartum separation of the

symphysis pubis and a sixth case of probable fracture of the pubic spine resembling the others in symptomatology, are the following:

1 Postpartum separation of the symphysis pubis is comparatively frequent.

2 The syndrome is so typical as to make its recognition easy. The chief symptoms are pain in the region of the pubic bones, a palpable separation, difficulty in walking and usually a typical waddling gait.

3 Separation of the symphysis pubis is invariably accompanied by a corresponding gaping of the anterior portion of one or both sacro-iliac joints. The limp is due chiefly to the instability of the pubic arch and to the weakness of the sacro-iliac joints, in less degree to the posterior displacement of the hip joints which instead of facing anterolaterally, face laterally.

4 The treatment must correct all three pathological lesions. This can be accomplished by applying a powerful compressive force to the pelvis which gradually rotates the innominate bones from behind, forward and mesially thus closing the gaping sacro-iliac joints and bringing the pubic bones into normal alignment.

5 Functional cure is possible even though a slight persistent separation of the symphysis pubis is roentgenologically demonstrable.

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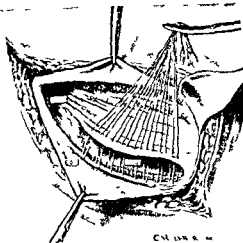


Fig. 6. The first second and third rows of sutures have been tied. The last row of sutures has been placed through Poupart's ligament *P* and the internal oblique *IOb*. If desired the end of the hypertrophied fascial sac *HFS* may also be brought down with this row. *EOb* External oblique.

held together by areolar tissue and forming a thin covering over the cord and testis. I have mentioned the cremaster fascia first because the marked hypertrophy which takes place is predominantly in the fascia; the muscle bundles increasing somewhat in size but becoming so thinned out that for all practical purposes there is only a fascial layer (Fig. 9). The attachment of the cremaster to Poupart's ligament is greatly increased both in extent and strength, due to the hypertrophy of fascia.

The infundibuliform fascia (internal spermatic fascia) is described as a funnel shaped thin membrane a prolongation of the transversalis fascia surrounding the cord and testis and enclosing them in a distinct covering (Fig. 2). The hypertrophy of this layer is very marked (Figs. 1 and 10) and of extreme importance because it is first the innermost layer of fascia, or the primary defense to be used in the repair and second it is attached around the entire circumference of the hernial ring even at the inner angle where the defense is most needed.

The essential features of this abnormal anatomy are (1) the hypertrophy of fascia with its increase of tensile strength, (2) the wide origin of fascia throughout the entire circumference of the hernial ring, no matter how large based embryologically on the fact that each layer is a funnel shaped process, and (3) the fact that all layers are already attached to Poupart's ligament thus providing a natural first line of de-

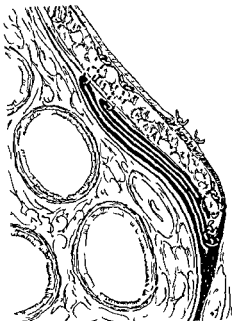


Fig. 7. Cross section showing the relation of the reduplicated hypertrophied fascial sac.

fense independent of sutures and the hazard of uniting.

The material used to illustrate this paper was obtained from the body of a laborer 74 years of age. It was impossible to ascertain the exact length of time during which the hernia had been in the scrotum, but approximately 10 years. There was no history of having worn a truss. The material for the photomicrographs were also obtained from the same cadaver and all have the same magnification.

#### A METHOD OF REPAIR<sup>1</sup>

The essential feature of the operation is the utilization of the hypertrophied fascia, commonly considered a useless structure and in the usual methods of repair, either partially excised or left as a bulky mass in the scrotum. While Figure 1 shows the layers dissected separately it is obvious that in the operative procedure they are tightly adherent and should be treated as one layer. The term hypertrophied fascial sac has been used to designate these layers for they form as true a sac as does the peritoneal covering. Only those steps are illustrated which differ from the usual hernial repair. For the sake of clearness the cord and testicle are shown as excised although this is by no means a necessary step.

<sup>1</sup>This procedure is an amplification of Halsted's method of utilizing the cremaster muscle but better applied to the combined fascial layers.

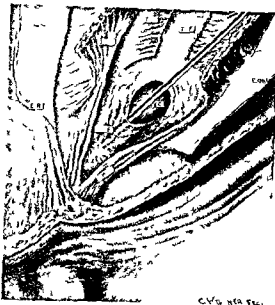


Fig 2 Dissection of normal side of the same cadaver. The intercolumnar fascia could not be developed and is not shown. Note the thin layer of infundibuliform fascia. *ER* External oblique. *IOB* Internal oblique. *TrM* Transversalis muscle. *TrV* Transversalis fascia. *CM* Cremaster muscle and fascia. *F* Fascia. *C* perineal cord.

Inasmuch as it is continuous with the aponeurosis of the external oblique it is necessary to incise this fascia transversely on the posterior portion



Fig 3 HFS Hypertrophied fascial sac dissected free from the cord and testicle. *EOB* external oblique. *IOB* internal oblique. *IF* intercolumnar fascia. *S* ligated peritoneal sac.

of the fascial sac in order to expose Poupart's ligament and thus free the lower flap of the external oblique aponeurosis.

The cremaster fascia (middle spermatic fascia) and muscle 1, described as loops of muscle fiber

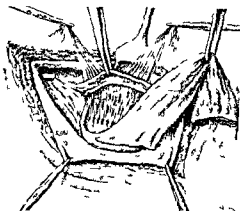


Fig 4 The first row of mattress suture has been placed and partially drawn up. The cut edge of the intercolumnar fascia is shown on the posterior surface of the hypertrophied fascial sac. *HFS* C Stump of cord shown as amputated for sake of clearance. *S* Ligated peritoneal sac. *EOB* external oblique. *IOB* internal oblique. *P* Poupart's ligament.

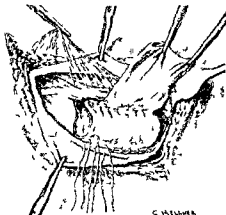


Fig 5 The first row of mattress sutures has been tied and is shown almost out of sight under the edge of the external oblique. *IOB* The second row of sutures has been placed through Poupart's ligament. *P* The third row of sutures is shown drawing a fold of the fascia upward beneath the internal oblique. *IOB* *EOB* External oblique. *IF* Cut edge of intercolumnar fascia.



Fig. 10 Above normal infundibuliform fascia (X80) below hypertrophied infundibuliform fascia (X80)

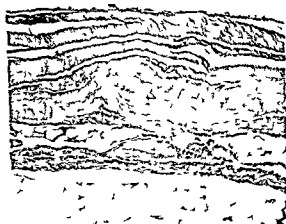
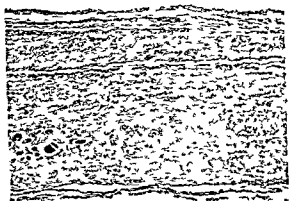


Fig. 11 Above hypertrophied fascia at just above testicle showing a few muscle bundles (X80) below fascia lata from the same case (X80)

These large scrotal herniæ do not fall into any well defined classification. From the standpoint of etiology they are almost invariably indirect while from the standpoint of repair they are direct as the defect has been carried well over to the rectus or pubic spine. An alternative method now much in vogue is the use of strips of fascia lata as described by Gallie. However, in these selected cases there is available fascia already growing *in situ* (Fig. 11) and already attached to Poupart's ligament and extending up on the edge of the rectus.

Some of the reasons for recurrence in these large scrotal herniæ may be summed up as follows: (1) large defects in the external oblique aponeurosis, (2) atrophy or defect of the internal oblique, (3) inability to approximate tissues at the inner angle or the tearing out of sutures under too great tension, (4) recurrence along a bulky cord where the ring is inadequately closed with atrophic muscle. These factors may be obviated by the procedure described in properly selected cases.

#### SUMMARY

- 1 Attention is called to the hypertrophy of fascia in scrotal herniæ.
- 2 A method is described for the utilization of this fascia in the repair of these herniæ.
- 3 On the basis of the abnormal anatomy and the fact that special procedures are needed in the repair, these large scrotal herniæ deserve a separate place in the clinical classification of inguinal herniæ.

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Fig 8 The hypertrophied intercolumnar fascia (X80)

If there is doubt as to whether the fascia is sufficiently hypertrophied so as to be of use in the repair, the early steps of the operation may be carried out in the usual manner until the hypertrophied fascial sac is incised parallel with the cord when its true nature is revealed. The peritoneal sac is dissected free, transfixed and doubly ligated as high as possible. The contents of the scrotum are readily delivered by following the cleavage plane between the intercolumnar fascia and the dartos when the cord and testicle can be dissected from the hypertrophied fascial sac (Fig 3). In large scrotal hernia there is not infrequently more fascia available than can be utilized, and it is then necessary to trim off portions, or, as has been done in some instances to cut strips for use in a Gallie needle. However, I believe the latter is unnecessary, for if the fascial sac is well developed, there is adequate material and little or no tension on the sutures. The lower edge of the internal oblique and transversalis must be freed from the peritoneum as high as possible so as to allow the first layer of mattress sutures to be placed at least 4 centimeters from its lower border. One should exercise care in placing the mattress sutures so that the reduplicated folds of fascia are not left loose but are barely taut. There is usually sufficient material for a reduplication of two to three folds the number depending on the size of the defect and the strength of the fascia. As has been pointed out by Koontz the union of fascia to fascia, or fascia to muscle is firmer if care has been taken to remove all of the intervening fatty areolar tissue. This is important as this hypertrophied fascial sac not infrequently has considerable fatty deposits. As there may be two rows of sutures in Poupart's ligament, the first row should be placed as low as possible. For this I have used a fine needle with silk as it gives a minimum of trauma. The aponeurosis of the external oblique may then be treated in the usual manner and if it is thought best not to remove the testicle, an extra aponeu-



Fig 9 Above normal cremaster muscle and fascia (X80) below hypertrophied cremaster muscle and fascia (X80)

rotic transplantation of the cord may be carried out.<sup>1</sup>

#### DISCUSSION

With the operation for inguinal hernia as used today, it is obvious that this type of repair will be limited to a small group of selected cases as the vast majority of them are repaired at a very early stage of development. However it is in this group that recurrence is most feared and in many instances expected. While the removal of the cord or testicle is acknowledged to be undesirable from a psychological standpoint, there is no sound physiological reason why it is not permissible in the group of cases of advanced age in which these hernia are usually found.<sup>2</sup> The percentage of recurrence will be still further lowered and the technique of repair is undoubtedly facilitated. However if desired, the cord can be transplanted in the usual manner.

<sup>1</sup>The method here described has been carried out on a group of selected cases during the past year and a half. While there has been no evidence of recurrence it is too early to report definite results.

<sup>2</sup>This, of course, assumes that the remaining testis is normal. At times in large scrotal hernia the testicle is already atrophic.



Fig 4



Fig 5



Fig 6



Fig 7



Fig 8



Fig 9



Fig 10



Fig 11

- Fig 4 Friction burn. Ear partially destroyed  
 Fig 5 Wound grafted. Plastic operation on ear  
 Fig 6 Present condition. Wound healed and ear restored  
 Fig 7 Before operation. Upper one third of ear absent  
 Fig 8 Tube graft  
 Fig 9 Lower pedicle of tube graft severed. Graft transplanted to ear  
 Fig 10 Graft growing to ear. Both pedicles severed  
 Fig 11 Final result

and depressions of the external ear are as pointed out by Luckett<sup>1</sup> due to fluting or folding of the cartilage. This deformity can be corrected by the removal of a crescentic segment of skin and cartilage from the posterior aspect of the ear. The cartilage is then sutured separately from the skin the sutures being passed in Lembert

fashion from one side to the other. Where these are tied the cartilage is rolled forward, thus producing a ridge on the anterior surface corresponding to the antihelix. Marked inequalities in the ears can be corrected by the removal of a portion of one ear through a V shaped incision. The excised portion can be transplanted to the smaller ear if the disparity is great.

<sup>1</sup>L. Luckett Surg. Cy. ec. & Obst. 91: 635-637



## PLASTIC SURGERY OF THE EAR

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**M**EDICAL literature up to the World War contains little reference to plastic surgery of the ear. This field of surgery offers unusual difficulties because of the complicated structure of the ear, its rather isolated position, and the necessity of transplanting cartilage for proper support of the improvised ear. Wounds of the World War, however, and accidents incident to the mechanical age in which we live have forced upon the plastic surgeon the necessity of devising ways and means of reconstructing the ear.

The great vascularity of the ear makes possible a variety of plastic operations upon it. It receives its blood supply from the branches of the superficial temporal, the occipital and the postauricular arteries. Greatest difficulty is encountered in the reproduction of the various eminences and depressions of the external ear and of the external auditory canal.

Defects of the ear demanding surgical intervention may be divided into (1) congenital and (2) traumatic or acquired.

## CONGENITAL DEFORMITIES

Congenital deformities may vary from entire absence of the ear to partially defective organs. The ears may be too large, the so-called "donkey ears" or "sail ears," or they may be too small. Large ears often prove a distressing deformity and subject their owner to humiliating ridicule.

The most difficult feat in plastic surgery is reconstruction of the congenitally absent ear. In the most advanced cases the auditory canal is usually lacking and it is impossible to form a canal. X-ray films will enable one to determine the presence or absence of the internal structures of the ear. Should these be lacking, the

most that can be hoped for is the formation of an external ear which will simulate a normal one. If only the lobe of the ear is present as in the author's case, the ear must be reconstructed from the scalp above and behind the ear and stiffened by transplanted cartilage. Cartilage grows readily if embedded in the connective tissue layers of the skin. Cartilage may be transplanted from a rib, from the opposite ear, or from the remnants of cartilage above the meatus of the deformed ear. The auricle is formed of flaps which are freed from the scalp by means of a butterfly incision and are folded upon themselves where they are sutured together with their raw surfaces in contact. Rigidity is secured by transplanted cartilage.

The incision first suggested by Szymanowski many years ago is useful in forming an auricle. Several operations are necessary, extending over a period of 2 or 3 years. The final results are often surprisingly good.

In case of total ablation of the external ear it is possible to transplant an entire ear from one person to another by using the back of the hand as an intermediary host for the grafted organ. Fitch has reported a case in which a young man had his ear completely severed from his head. He immediately picked it up and hastened to the doctor's office where it was cleansed and sutured in place. It healed perfectly. This would suggest the possibility of using the ear of a person recently dead as a graft.

Prominent or donkey ears are not uncommon; they constitute an actual deformity and are due to a change in the angle at which the ear joins the head. This leads to a bending forward of the auricle. In such ears the antihelix is undeveloped or lacking. The ridges which form the eminences



Fig 1 Congenital absence of ear

Fig 2 After second operation

Fig 3 Present condition

# EDITORIALS

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SEPTEMBER 1929

### WHEN SHOULD AN ILEOSTOMY BE PERFORMED IN CHRONIC ULCERATIVE COLITIS?

SIR SAMUEL WILKS,<sup>1</sup> as early as 1859, expressed the opinion that there was a difference between dysentery and certain forms of colitis, and in 1875<sup>2</sup> he separated "simple ulcerative colitis" from the other forms. His description of the symptoms and pathology cleared the way for later study and investigation, but his contention that the disease was a distinct entity was not accepted until quite recently. Those who have looked upon it as a separate disease have been unable to treat it satisfactorily and, until Bargaen began his work, no one had been consistent in his findings of the causative agent.

After Bargaen discovered a Gram positive, lancet shaped diplostreptococcus in the lesions of the colon of patients having chronic ulcerative colitis, he succeeded in making a vaccine with which he has successfully treated many patients. Interest in this autogenous vaccine treatment is intensified by its im-

portance in establishing the etiology of the disease. It is further heightened by the fact that there has not been in the past any one satisfactory treatment. Measures, such as medications, diet, and local irrigation have been varied and their results correspondingly uncertain and meager. Surgery when resorted to has certainly prolonged the lives of many patients but the type of operation which gives the best result—ileostomy—is in its postoperative phase an unhappy one for the patient to endure.

Bargaen has repeatedly isolated the diplostreptococcus since he began his investigations in 1923. A vaccine prepared from a pure culture of this organism and a bacterial filtrate injected subcutaneously has resulted at the Mayo Clinic in a complete cessation of symptoms in nearly one out of every two cases. For about three out of every four cases the improvement has been sufficient to allow the patient to resume a normal, active life. Results elsewhere have been less uniform. There are reports of the successful cure of patients treated with the vaccine, while there are others of a failure to isolate the organism described by Bargaen, and, where it was isolated, a failure to effect a satisfactory cure with the injections.

This brings us to the question: when should an ileostomy be performed in case of chronic ulcerative colitis? Since the striking reports of Bargaen's work, we have treated with autogenous vaccine five cases of chronic ulcerative colitis which we are reporting elsewhere.<sup>3</sup> These range from two very advanced

<sup>1</sup>Wilks Sir Samuel. L. Ct. res. n. P. thol. g. A. An. tom. y. 1859 p. 43  
<sup>2</sup>Id. 1875 p. 408

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## TRAUMATIC OR ACQUIRED DEFECTS

Here is the largest field for plastic surgery of the ear. The ear may be partially destroyed by malignant disease, by syphilitic ulceration or by trauma. The auricle of the ear is most often destroyed. Two such cases are illustrated. One of these was due to a friction burn of the scalp and upper third of the ear by a rapidly revolving motorcycle wheel. This ear was reconstructed by the removal of a V shaped piece from the under and inner surfaces of the auricle and suture of the denuded edges. The ear was reduced in size but its contour was excellent.

In another case a man had the upper third of his ear torn off in an automobile accident. The problem presented was to secure sufficient tissue to restore the auricle and render it rigid. The tube graft which came into use during the World War lends itself to the restoration of such defects. The entire operation can be done under local

anæsthesia. The graft is first prepared from the non hairy portion of the neck, two parallel incisions down to the fascia are made. The bridge of skin between these incisions is dissected up, folded upon itself and sutured. Particles of cartilage are taken from the tenth rib and embedded in the connective tissue of the graft. The skin is sutured beneath the graft. If tension is too great the edges may be undercut. At the end of 10 days the tube is severed at its lower end, its edges separated and accurately sutured with horsehair to the split and freshened skin of the ear. Ten days later the upper pedicle is divided and sutured in a similar manner to the posterior surface of the split auricle. The cosmetic result is excellent. In the case illustrated (Figs 7 to 11) the patient is so pleased with his reconstructed ear that he desires an operation on his normal ear, which is of the 'sail ear' type, to make it conform to the injured ear.

Latin noun "opus" and verb "operari," meaning "work" and we should not say that we work a patient. Operate is a transitive and intransitive verb. A transitive verb is one that requires a direct object to complete its sense. Thus we may correctly say "I operate a coal mine or a peanut stand or a cystoscope," "operate" being used as a transitive verb. In surgery, as far as the patient is concerned, operate is always intransitive. To satisfy our fondness for the use of the word operate and to use it correctly, we must limit our transitive use of the verb to operating the gas machine, the bone saw, the syringe, but we must not operate the patient.

The expression "plaster cast" is very commonly applied to a plaster splint which encircles, partly or completely, a limb or some part of the body. At the same time the word 'cast' is commonly used in medicine to designate a mold of a hollow organ, as of a renal tubule or a bronchiole. Thus we have blood, epithelial, fatty, granular, hyaline, waxy, and other renal casts. So on the same patient we have the word "cast" used in contradictory senses—concerning the kidney tubule or bronchiole for something that is inside—concerning the limb for something that is outside. The dictionary gives twenty-seven different significations for this word of Scandinavian origin, varying from the 'excrement of an earth worm' to "a throw of dice." The act of casting or founding, the quantity of metal poured, the impression or mold taken, that which is formed in a mold or form, a reproduction or copy of a work of art in plaster, are all correct uses of the word "cast." In the science of the treatment of fractures the meaning of the word "cast" has been twisted and misapplied to an apparatus or splint that comes in contact with some portion of the exterior of the body. This is evidently an abuse of the word, and

there is no authority for such use of the word except the authority of a bad habit.

Another expression of lesser ill, but manifestly improper, is the common phrase "Has the patient any temperature?" One might as well ask "Has the patient any respiration?" Of course, the patient, if alive, has a temperature. What should be asked is "Has the patient any rise, change, or variation in temperature, or any fever?"

The word "hæmorrhage" means a flow of blood. "Hæmorrhage" is a noun and there is no verb "hæmorrhaging" in the English language, yet this word strikes the ear occasionally and even creeps into print.

The word "pathology" is defined by Dorland as "That branch of medicine which treats of the essential nature of disease, especially of the structural and functional changes caused by disease." By a curious quirk, the original meaning has recently become dislocated from a study of diseased tissue to the disused tissue itself. We hear such expressions from the operating room and morgue as "no pathology of the gall bladder found," "exploratory incision revealed no pathology," and examination of chest plates conclude with the statement 'there is no pathology in the lungs.' We might as well say that the larynx shows no laryngology, the bladder shows no urology.

The terms "tuberculous" and "tubercular" are hopelessly mixed up. "Tuberculous" should be limited to any lesion or process caused by the bacillus tuberculosis, "tubercular" should be restricted to a condition in which tubercles or nodules are present.

We aim at accuracy in medicine. Exactness is necessary in prescribing, correctness is desirable in diagnosis and accuracy is indispensable in surgery. May we not profitably give some attention to correctness in medical English?

JAMES R. JUND

cases to one in an early, mild stage. In each instance the technique of Bargaen was followed in cleansing the colon by repeated enemas, in removing the exudate from the base of an ulcer, and in curretting the base with a sterile platinum loop to obtain the material for culture. Rosenow's method, as published by Bargaen, was followed in isolating the diplostreptococcus in pure culture and in preparing the vaccine and filtrate. In each of our five cases the result of the vaccine treatment was the same: a distinct improvement was noticeable soon after the injections were begun, this improvement continued and in a few months the ulcers in the colon were healed, and the patients were without symptoms. One patient, extremely ill when the treatment was begun, is now, a year and a half later, performing manual labor 11 hours a day.

When should an ileostomy be performed in chronic ulcerative colitis? Not until repeated attempts have been made to isolate the lancet-shaped diplostreptococcus, and, if the organism is found, not until the vaccine and filtrate injections have been tried. The technique which has been evolved after extensive experiments and research and which has given Bargaen such excellent results, should be followed. In the case of the occasional patient who is brought to the surgeon seeking relief because the organism described by Bargaen has not been found or because injections of stock vaccine have produced no improvement, and the patient's general condition is rapidly growing worse, ileostomy must be considered. Bargaen<sup>1</sup> reports that out of 250 cases treated with vaccine at the Mayo Clinic during a three year period, 19-4 1926, it was necessary in only five cases to do an ileostomy. Stone<sup>2</sup> reported seven cases

requiring ileostomy, and has suggested that it be employed "before the general condition becomes so serious as to be critical."

It seems that with the etiological factor well established and the autogenous vaccine treatment successful and in general use, the few cases requiring ileostomy will be those in which the vaccine or serum treatment has been a failure or those in which treatment has been neglected and the entire colon badly damaged.

EDMUND HORGAN

JOSEPH HORGAN

## CARELESS USE OF THE ENGLISH LANGUAGE

OUR British cousins use their language better than we do. A clinical lecture from a professional chair in London or Edinburgh is usually a model of correct speech. English medical literature is generally expressed in better constructed phrases with superior choice of words and expression of ideas than is the average product of American medical writers. The rush of American life is perhaps responsible for the neglect of polishing our sentences. It is related that Flaubert, the great French novelist, would spend days polishing a single sentence so that it would become pleasing to the eye and ear. Such extreme assiduity cannot be expected of busy medical men, but there are certain glaring errors commonly used in medical writing and conversation to which our attention may profitably be called.

The first and foremost atrocity is the misuse of the word "operate." Such expressions as "I operated him" "The case was operated" and similar abominations appear frequently in our standard medical journals, are used in conversation and worst of all, are taught to the student in some of our best medical colleges.

The word "operate" is derived from the

<sup>1</sup>Bargaen, J. A cold. Char. ul. crati. e. col. tis. bacteriologic studies and specific therapy. Tr. Am. Proctol. Soc. 1927, 28th An. 100-101.

<sup>2</sup>Stone, Harvey B. Ch. on ulcer. col. tis. Pennsylvania M. J. 1929, 33: 211-218.



CHARLES B. PENROSE  
1862-1925

# MASTER SURGEONS OF AMERICA

CHARLES B PENROSE

ALL men are born, and die Most men marry Many men fill, and worthily, public positions, are members of important commissions or boards, acquire wealth These are matters of import during the life of the individual, or shortly thereafter, and to those with whom he has had social, professional or business relations The data bearing on these matters are appended to this memorial

As to the Penrose forbears, his brother, Richard A F Penrose geologist of international reputation, president of the Academy of Natural Sciences, founder and one time president of the Society of Economic Geologists, answered a query on this subject as follows "On my father's side our first ancestor in this country was Bartholomew Penrose, who came to Philadelphia with William Penn about 1700 On our mother's side our direct ancestor was Governor Dudley of Massachusetts Our ancestors on both sides have tried to be respectable, law abiding people "

Charles B Penrose was one of a family of long, strong, lean, handsome, active boys guided in childhood by their exceptionally able gifted, and devoted mother, later by their cultured and distinguished father, Dr R A F Penrose, professor of obstetrics in the University of Pennsylvania To him, their father, because of his worldly wisdom deep affection, and abiding belief in them, they rendered respect and obedience With him, because of his vivid interest, full understanding, and large charity, they were as unrestrained in thought, word, and action as with each other

Charles Penrose's first school was the Episcopal Academy, thence he went to Harvard, while a student contributing to scientific journals papers upon mathematical and physical subjects He graduated with highest honors in physics in his nineteenth year Such was his aptitude for this branch of science that, together with his A B degree, he was offered an assistant professorship, in the belief that he might become one of the leading physicists of his generation

On leaving Harvard he entered the medical school of the University of Pennsylvania, at the same time continuing his studies in mathematics and physics at Harvard, where by special permission of the University Council and on condition that he should spend two months of each yearly term at Harvard, he was



CHARLES B. PENROSE  
1862-1905





allowed to try for the degree of Ph D In the spring of 1884, and at the age of twenty two, he was given the degree of M D by the University of Pennsylvania and that of Ph D in physics by Harvard

After completing his internship at the Pennsylvania Hospital, and while attached to its out patient department and that of the old Philadelphia Dispensary, Penrose, operating in cellar and attic, convinced the profession that recovery from abdominal section could be made habitual rather than occasional, and that thereby many women condemned to a life of misery or a speedy death could be made well It was about this time that the professor of surgery of the University of Pennsylvania characterized the abdominal operations of his colleague, the professor of gynecology, as "legalized murder"—and with some justice in so far as mortality was concerned

It was while he was demonstrating, to a then skeptical profession, the safety of clean, deft, abdominal surgery, that as an outlet to his super abundant vitality, Penrose swam the thirteen miles from Philadelphia to Chester Thereafter though not necessarily incident thereto he suffered from a persistent cough with fever and loss of weight Hoping that air, altitude, sunlight, and exercise might cure him he went to Cheyenne and dug with a shovel daily, leaving a landmark to which strangers were taken for years Dr A W Barber, then governor of Wyoming, wrote at this time "Penrose is past all help I doubt if you ever see him again "

When the big cattlemen with their cowboys and killers rode through Cheyenne on their mission of rustler extermination Penrose joined them as surgeon, but was taken so desperately ill that in spite of his protests he was sent back to the town of Douglas He was jailed on sight, which saved him from being shot Believing his bichloride tablets were intended for poisoning the wells, lynching was promptly decided upon, but postponed until morning in the interest of a larger audience His cellmate, red handed murderer and horse thief, offered him half of a pair of scissors, holding that suicide even by such a poor instrument was better than hanging A special train from Cheyenne sent by Governor Barber, carrying a United States marshal, robbed the mob of its anticipated pleasure, for which its appetite had been whetted by shooting through the cell window most of the night

From Cheyenne he went to Silver City New Mexico, where he made a rapid and complete recovery Thereafter he married Miss Kathryn Drexel, of New York, and accepted the professorship of gynecology in the University of Pennsylvania This department he organized and administered with his characteristic skill and thoroughness His textbook on *Diseases of Women* was welcomed as a standard He taught rational, clean, gentle surgery by word and hands in a way both convincing and proselytizing He had the hero worship of his students, the confidence and respect of his colleagues, a large consulting and private practice, and a leading place among the surgeons of America

A recurrence of his lung trouble forced him to resign all this and to devote himself to its arrest or cure

To meet the obvious and urgent need of a hospital for women, Penrose founded, organized, incorporated, and, through his friends, financed the Gynecean Hospital (1887), having associated with him at first Dr Joseph Price, then Drs D Hayes Agnew and J Montgomery Baldy, the latter most ably carrying for many years the surgical and executive burden of the institution

During the late war and thereafter, Penrose and Baldy, in the larger interests of public health and because the need seemed urgent, devoted the hospital to the sequestration, until rendered non contagious, of venereally infected women sent by the Municipal Court Room was made for sixty, a dispensary with an average attendance of one hundred was opened nightly for those not under court control Threatened failure of the city to co operate in more extensive plans having for their end the lessening of venereal incidence, led to the closing of the Gynecean Hospital in 1924 In accordance with Penrose's wish the interest from the Gynecean Estate of something short of a half million dollars has been devoted to research, now being conducted under the supervision of the gynecological department of the University of Pennsylvania

In 1903 he conceived and created the Pennsylvania Department of Health, giving to its commissioner extraordinary power His conception was put in such impregnable legal phraseology by Mr Eli K Price that all attacks upon it have failed Penrose saw personally every member of the legislature the night before the passage of his bill and named the first commissioner of health, Dr Samuel G Dixon This might not have been possible except for the active support of his brother, Honorable Boies Penrose, then and until his death the dominant influence in both state and national politics

In 1899, Penrose was appointed a member of the Game Commission of Pennsylvania<sup>1</sup>, becoming its president in 1911 From the beginning of his service there in he was director of its policies

Dr Grinnell writes "For a matter of twenty years Penrose was the leading man on the commission He devoted to it more time and energy than all the others put together No legislation was passed and nothing was done that he did not approve"

From the beginning of his direction of the Zoological Garden of Philadelphia Penrose pursued the policy of making an exhibit unrivaled both in the variety of animals shown and in the maintenance of their health He, with the assistance of Drs William Pepper, M T Ravenel C Y White, Leonard Pearson, and Herbert Fox, conducted autopsies from the findings of which the principles of preventive

<sup>1</sup> Pennsylvania, when thirty four game fuges, not counting about 130, are said to be added by three to four million rabbits the state is benefited by nearly 800,000 dollars a half million of these are said to be the property of the state in the sand turkeys and their game birds and animals are said to be the property of the state

medicine were so applied that, among other betterments in animal health tuberculosis in the monkey was practically abolished.

C. Y. White, the first pathologist, was succeeded by Dr. Herbert Fox, whose studies and publications have proved Penrose's belief that a zoological garden may be not merely an exhibit but a school, having as its main function, contributions to science.

His struggle for health was amazingly successful. When after a period of intensive work his warning came, he hunted, fished, and explored, in the Rockies, the uplands of the South once in Venezuela. After months of life in the open he came back well. In the spring of 1920 his warnings came and more urgent than ever before—he planned a longer trip than usual, but was held all that summer by the illness of his brother. Nights and days of unremitting care accomplished the impossible. None knew better than Charles Penrose that he was giving his own life for that of the Senator and that when the time of rest came the sun and air could no longer bring back that which was so far spent.

A banker once spoke slightly of Abraham Lincoln "because he left a small estate." Lincoln left a continent in peace and honor to now one hundred and ten million people. No larger legacy is recorded in history. Even from the narrow standpoint Penrose would have commanded the banker's respect. From the broader one, to many millions he left a longer life, a better health, forests, game in abundance, a zoological garden of first rank contributing largely to science, and a department of research.

Penrose was strikingly handsome, standing six feet and of powerful build. Till within a year of his death, he presented the color, bearing, and appearance of rugged health. He was unemotional undemonstrative on the birth of his son, a lady whose life he had saved and who spoke of him as having the face of Endymion, hands of velvet and the tread of a marching regiment, said "Aren't you thrilled at the coming of Little Boy Blue?" He answered "He is not a blue baby. I am not thrilled, but of course, the young of all vertebrates are interesting."

With him all policies were subject to cold deliberation. When approved by reason they were followed by prompt action, the details of which were carefully planned and carried out with a tireless persistence which neither hurried nor delayed. He loved power, but never its display. He shunned publicity and condemned with extraordinary vigor of diction those to whom it came either by choice or chance. Law-abiding, he bitterly opposed the encroachment of national authority over that of the state and the interference of both with individual rights and privileges.

He shot in perfect form, deliberately and with deadly accuracy. He was a good farmer and gardener, a good horseman, a good fisherman, an admirable host, skilled in cooking, exacting and securing the best, a good sailor. All things he did well, deliberately and efficiently.

On one of his hunting trips, while about to skin a grizzly which he had shot, he was rushed by another bear and severely clawed and bitten before he succeeded in killing it. His own clean surgery promptly applied saved his wrist joint from which the bones were protruding, and, probably, his life.

One hundred years from now a research fellow, passing through the hall of the medical school, may stop for a moment, arrested by the extraordinary beauty of a face painted by Julian Story with more than his usual richness of coloring and delicacy of touch. "Charles Bingham Penrose, professor of Gynecology, 1892-98." Intellect of a high order, strength, determination, ability, all these the artist has written for the reading of those to come. The Fellow may ask why has such a one left no record other than of his brief professorship, little realizing that rich legacy, in which he himself at that moment is sharing, a legacy which grows with the passing years.

EDWARD MARTIN

Born 1862 Married 1892 Died 1925 A.B., 1881; A.M., Ph.D. 1884 (Harvard) M.D. (class president) 1884 D.Sc. 1910 (University of Pennsylvania) Resident physician, Pennsylvania Hospital, 1885-86 Founder and surgeon of Gynecoean Hospital 1887-99 Surgeon to the German Hospital 1890 Professor of gynecology University of Pennsylvania 1893-99 Retired from active practice, 1899 Member of the Phi Beta Kappa Society College of Physicians of Philadelphia American College of Surgeons American Philosophical Society Academy of Natural Sciences Park Commission of Philadelphia, American Association for the Advancement of Science President of the Zoological Society of Philadelphia, president of the Game Commission Commonwealth of Pennsylvania Member of the Pennsylvania Society of Descendants of Colonial Governors Harvard Club The Union League the Philadelphia Club The Racquet Club, Corinthian Yacht Club Radnor Hunt Club University Barge Club The Rabbit The Jury Principio Gunning Club, Maryland Henry's Lake Club Idaho Sand Bridge Club Virginia Mud Hole Meadow Club New Jersey The Wilderness Club The Boone and Crockett Club



# *Medicæ artis principes,*

*post Hippocratem & Galenum*

Græci Latinitate donati,	<i>Albanus,</i>
<i>Aretæus,</i>	<i>Nic Myrepsus</i>
<i>Ruffus Ephesus,</i>	
<i>Oribasius,</i>	Latini,
<i>Paulus Aegineta,</i>	<i>Corn Celsus,</i>
<i>Actius,</i>	<i>Scrib Largus,</i>
<i>Alex Trallianus,</i>	<i>Marcell Empiricus</i>
<i>Aliique præterea, quorum unus nomen ignoratur</i>	

Index non solum copiosus, sed etiam ordine  
artificiose omnia digesta habens  
Hippocr aliquot loci cum Corn.Celsi interpretatione.

Henr. Stephani de hac sua editione testificatio.  
Quæreret quos ægri per compita multa solebant  
Hospita nunc per me est omnibus una domus  
Præter Galienum et alios quosdam dextera  
Sustendit medicos nonne secunda mihi?



ANNO M. D. LXVII  
Excudebat Henricus Stephanus, illustris viri  
Huldrici Fuggeri typographus.

# THE SURGEON'S LIBRARY

## OLD MASTERPIECES IN SURGERY

ALFRED BROWN M D F A C S OMAHA NEBRASKA

### THE CHIEFS OF THE ART OF MEDICINE BY HENRI ESTIENNE

THE publication of the *Medical dictionary* by Henri Estienne in 1564 apparently did not satisfy his urge for medical editing. He had spent seven years going over and collating the manuscripts of many writers and as the result of this immense labor had produced a small book which, though not voluminous, stood as the greatest triumph in medical nomenclature extant at this time. The book must have seemed too small to represent all this work and added to this thought or idea there may have been the further desire to excel his great competitor, the Aldine Press, which had in 1547 published its beautiful edition of the *Collected Works of the Ancient Medical Writers*. A comparison of dates makes one wonder whether the Aldine edition was not the primary cause of Estienne's starting on the dictionary for he says he worked on it seven years and the two books were published that many years apart. Further, the authors studied and published in the two works conflict very seldom and the list of Estienne contains the greater names of the two.

Whether or not the speculation as to reason is true, the fact remains that in 1567 Estienne published in full the works of the authors whose medical terminology he had elucidated in his dictionary. The work comprises two great folio volumes and was printed as was the dictionary with the help of Huldreich Fugger who was still apparently financing the press.

There was a certain amount of publisher's jealousy behind the printing of these works for in the preface to the volumes Estienne is most uncomplimentary to the rival printing house of Aldus which had published Latin translations of the works of Aetius of Amida and Paulus of Aegina both of whom Estienne includes in his collection. In fact the introduction to the preface which is in the form of a letter to his friend William Hancius is written in a rather polemic vein. He begins by saying that if any one asked him what he had to do with medicine or Hippocrates or Aesculapius or any other medical affairs he would answer as did Terence that he was a man and considered him self only human. Evidently inferring that he was interested in the subject and would be perfectly satisfied if others minded their own business. When he refers to the Aldine publications he becomes really insulting for he says

'what other therefore is the edition of Paulus of Aegina and Aetius which is produced by the heirs of Aldus than a foul collection of all forms of errors.' He goes on to say that some of the mistakes are imputed to typographical errors and some to mistakes and imperfections in the original text. He then says that in his edition he has corrected all of the errors that can possibly be corrected. After the unpleasant portion of the preface the editor goes on to describe the book and its arrangement with special reference to the index and finally dedicates it to his friend Hancius.

Estienne has made a most excellent selection of authors for his volumes which contain a veritable mine of information about ancient medicine. The authors chosen represent the best in medicine of the Roman and Byzantine periods and the wording of the title page is not at all too far fetched when it says 'The Chiefs of the Art of Medicine after Hippocrates and Galen'. The volumes contain the works of these authors rendered into Latin by the famous scholars of the period and the whole is edited by Estienne. The works of Aretaeus and Rufus are translated by Crassus, who writes his own dedication to Albert, Prince of Brandenburg, John Gunter of Andernich translates the work of Alexander of Tralles and dedicates it to Prince William of Hesse. Janus Cornarius interprets Paulus of Aegina and Aetius of Amida and adds many pages of explanations of his translations, and so on through the two folio volumes.

A very interesting portion of the second volume for the surgeon is the translation of the works of Oribasius on nooses (knots) and machines by Vidius of Florence. Vidius had published his surgery in 1543 while he was in Paris and included much of the work of Oribasius. In the fragments in this volume he gives the two works as noted above and illustrates them profusely with beautiful wood cuts but unfortunately does not give the illustrations of bandages. The illustrations of the machines used in the reduction of fractures and dislocations differ from those in Vidius' earlier work and on the whole are clearer though not so artistic. The nooses or knots used for traction are very ingenious and show various methods of getting pull on the different parts of the extremities without constriction which are as valuable today as in the early days of surgery and would well repay careful study with the object of present day use in mind.



## REVIEWS OF NEW BOOKS

THIS book is a second edition of the well known work on the subject of X ray diagnosis of gas and intestinal diseases by E. Stierlin<sup>1</sup> which for many years has been a foremost book in X ray literature. Chaoul has greatly enlarged the work and the result is a book of greatest detail and thoroughness in presenting the clinical X ray phases of this special diagnostic work. The large volume is replete with illustrations that are clear and with text that is in keeping with the work of a master. Chaoul who is a professor in the University of Berlin dedicates the book to Sauerbruch who writes an introduction. The author spent many years in association with Stierlin in Basel, Munich and Berlin which should make him pre-eminently the one to revise enlarge and bring up to date the original work on which the present book is based. The subject matter is presented in not only the X ray aspect but also in its anatomical, physiological, symptomatological and pathological phases. Especially noteworthy is the work on studies of X ray shadows of the gastric mucosa, the folds and markings of which are presented most admirably. This is done with the use of exceedingly small quantities of the opaque medium and special external pressure to thin the material between the anterior and posterior gastric walls by which maneuver small lesions of the mucosal surfaces are detected. One can but express the wish that this splendid German work could be made available to English reading physicians. E S B

AT last! Koehler's book<sup>2</sup> in English! Roentgenologists conversant with German X ray literature have often repeated the wish that this book should be available to those who read only English. Koehler's original book was published in 1920, went through several editions, and proved indispensable to many X ray workers. This English version will be eagerly welcomed and will give much satisfaction to the many who know of the great value of the original work but who had not been able to use it as it was written in German. The book gives one the benefit of the accumulated experience of one of the world's leading masters in roentgenology and it contains many excellent illustrations and diagrams. The original work has been greatly enlarged and amplified.

One notes that the title of this English book is 'Röntgenology' the German spelling being used. This seems to be adding another variant to the already too numerous terms used in the X ray art at a time when serious efforts are being made to reduce

the terminology. It has the advantage of eliminating one letter from the English equivalent 'Roentgenology'. The author is conservative in his statements which is commendable in these days when X ray writers do not always give out mature opinions. The material given is up to date but Koehler does not bring in X ray procedures untried or unproved. The Graham gall bladder test is accorded a very brief presentation. This of course does not detract from the value of the book. The heart and aorta are given considerable space and there is a satisfactory exposition of the X ray knowledge in the gastro-intestinal tract, the urinary system and abdominal and pelvic conditions. The book contains what is probably the best exposition of the diagnostic features of bone and joint conditions that has appeared to date and its particular and peculiar value lies in the precise descriptions of shadow complexes that are abnormal in appearance but are definitely not pathological in significance. A most commendable feature in the manner of presentation of anatomical parts is the fact that the author starts from the fingers and toes and proceed upward so that the searcher can quickly locate the text that covers a particular region. Note is made of the author's extended exposition of the peculiar lesion which involves the head of the second metatarsal bone to which his name has been attached and over which there seems to be considerable debate.

As the book treats of the borderlines between normal and pathological, it contains fewer frank and advanced lesions than is usual in most books on the subject of X ray diagnosis and there are no sections that deal with any one type of lesion, the various lesions being found distributed throughout the book under the various special anatomical parts. The student of X ray diagnosis who follows the material given in this book will make few errors of interpretation. The many variations of the normal which one encounters almost daily are puzzling even to roentgenologists of large experience who too will find the book an indispensable addition to their libraries. Fraser states in a preface to the English edition. This book is a veritable mine of information. Case in his preface to the American edition says. Koehler's monumental book supplies the data on which a decision may be safely based.

This book can be recommended without reservation as an authoritative work on the borderline between the normal and pathological in X ray diagnosis. E S B

ROQUES monograph on *Epidemic Encephalitis in Association with Pregnancy, Labour and the Puerperium*<sup>3</sup> is well written and very instructive.

<sup>1</sup> EPIDEMIC ENCEPHALITIS IN ASSOCIATION WITH PREGNANCY, LABOUR AND THE PUERPERIUM. By Frederick Roques M.A., M.D., M.Chir. (Camb.) F.R.C.S. (Eng.). Manchester: H. K. Lewis & Co., 1925.

<sup>2</sup> E. STIERLIN'S KLINISCHE RÖNTGENDIAGNOSTIK DES VERDAUUNGSKANALS. 2. Aufl. rev. ed. By Dr. H. Chaoul. With a Foreword by Ferdinand Sauerbruch. Berlin: J. F. Schöner, 1925.

<sup>3</sup> RÖNTGENOLOGY: THE BORDERLANDS OF THE NORMAL AND EARLY PATHOLOGICAL IN THE SKIAGRAM. By Albert Koehler. Rev. ed. 1925. English from the Fifth German Edition by Arch. r. Turb. II. M.A. B.Sc. M.B. Ch.B. (Glouc.). New York: William Wood and Company, 1925.

The author reports 40 cases collected in England and 171 cases collected from the literature

The subject has been treated in an exhaustive manner each subdivision being fully discussed and substantiated by tables of statistics

The reviewer can give only a brief résumé of the conclusions reached which are as follows: The course of acute epidemic encephalitis is not altered in a woman by the fact that she is pregnant. Evacuation of the uterus seems not to improve the patient. The disease does not ordinarily produce abortion. In the majority, pregnancy is wont to proceed to term. Labor is usually painless. The infants are healthy at birth and remain so in a large percentage. Encephalitis epidemica neonatorum is a definite clinical entity although rare. The infection seldom passes via mother's milk.

Parkinsonism is a frequent complication following encephalitis and pregnancy makes the patient worse as a rule. Therefore patients should be advised not to become pregnant until a lapse of 4 years from the recovery from encephalitis. EDWARD L. CORNELL

FOR many years F. Sauerbruch's *Chirurgie der Brustorgane*<sup>1</sup> has been the outstanding work in surgery of the chest as far as wealth of subject matter and illustrations are concerned. Appearing first in a single volume in 1911 when the field of chest surgery was small, the *Chirurgie der Brustorgane* has enlarged as the field itself has grown. In 1920 the second edition, a two volume work, was published. The first part of volume one of the third edition has reached the hands of the reviewer.

For those who are not familiar with the second edition of *Die Chirurgie der Brustorgane* it should be

<sup>1</sup> DIE CHIRURGIE DER BRUSTORGANE. By Ferd. Sauerbruch, 3d. Vol. I.—D. F. k. anknungen d. r. Lungen. With the c. laborat. f. H. Altmann, H. Chroust, H. W. Felix, Hartl—Anatomie, Hg. pathologische Physiologie, Hg. allgemeine Diagnostik, allgemeine Technik, Lungen u. der Brustwand Verletzungen u. Bru. f. H. d. Lunge u. Bronch. k. u. Operation d. Embolien d. Lung. arterien. Berlin Julius Springer 1918.

said the subject of chest surgery is covered from beginning to end in a painstaking, thorough, and masterful way. Anatomy, physiology, pathology, diagnosis and technique of all the pathological conditions of the chest which lend themselves to surgical treatment are discussed completely and minutely. The illustrations which number in the neighborhood of fifteen hundred are of several types: photographs, drawings, diagrams, reproductions of roentgenograms, and lastly some of the most beautiful colored plates the reviewer has seen in surgical text books. The diagrams and photographs and plates are extremely helpful to the reader and in themselves would stamp the work as one of the outstanding medical treatises.

Although the work is uniform throughout it comes from the pens of several authors.

The text is clear, the subject matter is easy to find and an excellent bibliography is appended. The second edition of this work is the international classic on chest surgery.

Now appears edition number three of which only the first part of volume one has been received by the reviewer.

Volume one part one contains 907 pages and 916 illustrations. In form and general construction it resembles its predecessors. Many of the plates of the latter have been used. However much has been added for example the subject of lung mapping by means of the intrabronchial instillation of roentgen opaque matter which was not dealt with before, is now covered.

Volume one deals chiefly with general subjects: anatomy, physiology, general pathology, and general technique; a few special subjects are covered.

In short, Sauerbruch's *Chirurgie der Brustorgane* is being brought up to date to cover the rapidly growing field of chest surgery, and evidently when the third edition is completed will maintain its place as the standard treatise on the subject. R. B. B.

## BOOKS RECEIVED

Books received are acknowledged in this department and such acknowledgment must be regarded as a sufficient return for the courtesy of the sender. Selections will be made for review in the interests of our readers and as space permits.

THE TREATMENT OF FRACTURES. By Lorenz Boehler. M.D. Authorized English translation by M. L. Steinberg, M.D. Vienna: Wilhelm Maudrich, 1920.

RAPID TREATMENT OF CANCER. By Stanford Cade, F.R.C.S. (Eng.). New York: William Wood & Company, 1920.

AN INTRODUCTION TO THE STUDY OF PHYSIC (Now for the First Time Published). By William Heberden (1701-1801). A relayed Essay by LeRoy Crummer with a Reprint of Heberden's 'Some Account of a Disorder of the Breast'. New York: Paul B. Hoeber, Inc., 1920.

THE MEDICAL DEPARTMENT OF THE UNITED STATES ARMY IN THE WORLD WAR. Vol. XII.—Pathology of the

Acute Respiratory Diseases and of Gas Gangrene Following War Wounds. Prepared under the Direction of Maj. Gen. M. W. Ireland, the Surgeon General, by Maj. George R. Callender, M.C. and Maj. James F. Coupland, M.C.

THE ART OF SURGERY: A TEXT BOOK FOR STUDENTS AND PRACTITIONERS. By H. S. Souttar, D.M. M.Ch. (Oxon.). I.R.C.S. (Eng.). New York: Paul B. Hoeber, Inc., 1920.

LA PRATIQUE CHIRURGICALE ILLUSTRÉE. Vol. XIV. By Victor Pauchet, Paris. Gaston Doin et Cie, 1920.

THE AUTONOMIC NERVOUS SYSTEM. By Albert Kuntz, Ph.D., M.D. Philadelphia: Lea & Febiger, 1920.

DIAGNOSIS AND TREATMENT OF DEFORMITIES IN INFANCY AND EARLY CHILDHOOD. By M. F. Forrester Brown, M.S., M.D. (Lond.). With a Foreword by Sir Robert Jones, Bart., K.B.E., C.B., F.R.C.S. New York and London: Oxford University Press, 1920.

# AMERICAN COLLEGE OF SURGEONS

## A GROUP OF SECTIONAL MEETINGS OF THE AMERICAN COLLEGE OF SURGEONS

INTRODUCTION BY BOWMAN C. CROWELL, M.D.,  
ASSOCIATE DIRECTOR

**I**N addition to the annual Clinical Congress of the American College of Surgeons which is held in the larger clinical centers, it has been the custom of the College to hold sectional meetings in various parts of the country each year.

These meetings offer to many who are unable to attend the Clinical Congress an opportunity for visiting clinics, for discussion of hospital and scientific problems and for closer personal contact than is possible at the larger Annual Clinical Congress. They also offer an opportunity for informing the public on matters pertaining to health and disease.

The general plan of these meetings is to hold sessions during two days. Clinics are held in the local hospitals, a scientific program is presented by the surgeons of the section, hospital standardization meetings are held under the direction of the director of hospital activities, business meetings of the Fellows of the College take place, and a public meeting is held during one evening.

At this public meeting the speakers are men of national prominence who address the audience often with illustrated lectures on matters pertaining to hospitals and the personal health of the people. Such subjects as cancer, goiter, pre-natal care, scientific medicine and personal health examinations are frequently topics of discussion.

In 1929 sectional meetings were held in Phoenix, Arizona, Los Angeles, California, Vancouver, British Columbia, Regina, Saskatchewan, Winnipeg, Manitoba, Minneapolis, Minnesota and Lincoln, Nebraska. In addition to these meetings some of the traveling group met with local county medical societies where they presented a program and visited hospitals in El Paso, Texas, San Diego and San Francisco, California, Portland, Oregon, Seattle, Washington, and Omaha, Nebraska.

Among those who attended the entire group of meetings were Dr. Charles L. Scudder of Boston, chairman of the Committee on the Treatment of Fractures, Dr. Burton J. Lee, New York, member of the Committee on the Treatment of Ma-

lignant Diseases with Radium and X-ray, and Mr. Robert Jolly, Houston, Texas, superintendent of the Baptist Hospital. The diaries of these three gentlemen follow this brief introduction.

REPORT OF CHARLES L. SCUDDER, M.D., CHAIRMAN OF THE COMMITTEE ON THE TREATMENT OF FRACTURES OF THE AMERICAN COLLEGE OF SURGEONS

Through the courtesy extended to me as chairman of the Committee on the Treatment of Fractures of the American College of Surgeons I was permitted to accompany officers of the College on an official trip through the western states in the spring of 1929. It is an honor and privilege to make a brief report of the impressions and observations gained on that journey. I attended these meetings primarily (1) to gain information regarding the fracture situation in the parts visited, (2) to stimulate further interest in fracture treatment, and (3) to appoint subcommittees to serve as regional committees on the treatment of fractures.

In general I may say that the whole series of meetings was wonderfully well planned. The itinerary had been worked out so that rarely were we obliged to travel successive nights by train. The hotel accommodations were always comfortable and adequate, the best. Local men conducted clinics and participated freely. The meetings—clinical, scientific, and public—had been well advertised and were well attended by keenly interested men and women. The programs as educational factors certainly fulfilled the fondest hopes of those in charge. Scientific meetings with papers and demonstrations contributed to the variety of the program. The hospital conferences at which doctors, laymen, trustees and sisters mingled were vital meetings at which practical hospital problems were discussed and at which questions were raised and answered. These hospital conferences under the remarkable leadership and support of Dr. Malcolm MacEachern and with the stimulating assistance of Mr. Robert Jolly, of Houston,

Texas, were conducive to real progress. All hospitals in each community were visited.

I was impressed by the tremendous going capacity for accomplishment of the active organization of our American College of Surgeons. Those of us who live east of Chicago little realize the problems of the physician in the middle, southern, and northwestern United States and Canada and how the College is meeting these problems. I believe that the sectional meetings, the community health meetings, the clinical meetings, and the hospital conferences of our American College of Surgeons—all these College activities as conducted—are productive of great good. Moreover, these meetings are appreciated—physicians and surgeons attend, take part enthusiastically, and say that they receive benefit from them. I have been impressed by the great efficiency of the machinery of the College to function in an educational way and I believe that the results as regards the general uplift of the profession will endure.

Where no sectional meetings were held, we attended clinical meetings of county societies at El Paso, Texas, San Diego and San Francisco, California, Portland, Oregon and Seattle Washington.

At each place in presenting the subject of the treatment of fractures, I attempted to become familiar with local conditions through answers given to the following questionnaire:

- Who is taking care of fractures?
- Who is doing the industrial accident work?
- Who is interested in fractures in the various hospitals of the city?
- Is the workmen's compensation act well administered?
- Are there malpractice suits because of poorly treated fracture?
- What is the special type of fracture seen in this community?
- Is any one doing research on fractures?
- Is the orthopedic surgeon interested in fracture?
- What kind of work is he doing?
- Are there tabulated fracture services in the hospital?
- Is there a well equipped plant room in the hospital?
- Does the teaching center have any effect on service rendered the fracture patient?
- What is the effect of the open hospital on fracture treatment?
- Do standards of results vary?
- What is the status of the operative treatment?
- Are general practitioners interested in fracture treatment?
- Are general surgeons interested?

The answers to these questions put me in touch with the fracture situation in each locality. The questions were not always answered completely but their presentation led to discussion and to the gaining of information.

The meeting at El Paso, Texas, not only presented the local situation but through the co-

operation of Dr. Miller, the president of the Texas State Medical Association, opened the way to the appointment of tentative committees in fracture work in the towns of the great state of Texas. It is my hope to be able again to visit Texas and to confirm the interest said to exist in fracture treatment in that state.

### *Impressions gained*

Interest in the treatment of fractures is growing through this western country.

The general surgeon is interested only exceptionally. Very few surgeons are competent to handle all fractures and all their complications.

The man practicing orthopedics is interested outstandingly in fracture treatment.

A great deal of personal experimental work is being done. Technique is being used which is not methodical and without sound foundation—methods which have been found inadequate and unsatisfactory in other localities. Inefficient traction methods are being employed. Operative replacement are too generally resorted to. The indications for the use of the operative treatment are not clearly defined.

The surgeons are well informed concerning pathological processes and are well versed in the indication for the surgical treatment of such lesions.

There is no general body of knowledge of the fundamental of fracture treatment. The anatomical result of the attempted reposition of a fracture varies often as the only basis for treatment. In certain sections the desire to secure an exact anatomical result as indicated by the X-ray is the basis for an early operative replacement. This attitude is urged because should there be a trial in court the decision of the court is based largely on the exactness of the reduction rather than on the amount of function of the part.

The centers which have teaching hospital and a moderately closed or controlled hospital staff are as a rule doing the best work. A wide open hospital is not conducive to sound work in surgery particularly in fracture surgery.

Personal jealousies and rivalries exist as in every community. Factors are allowed to influence progress.

A tendency is found to ignore and not to help the younger men of the profession to positions on the staff of hospitals. The older men tend to hold on to staff positions and appointments beyond a useful period. I think that there is a failure to recognize the fact that after a certain time the experience obtained by hospital contacts will carry the surgeon along and that relinquishing that official relationship to the coming generation reacts well on both the older and the younger group.

As to the present methods of treating fractures it may be said that information regarding fracture treatment is noticeably lacking in uniformity. The generally accepted bases for treatment are not always recognized. As a result, experimental forms of treatment are duplicated to the detriment of both patient and physician.

In certain fractures of the long bones it is pretty commonly understood that skin traction with a small weight gradually increased will not be effective. Despite this fact I found this inadequate and obsolete form of treatment many times in

use Obviously, dissemination of information on this point through the local regional committees recently formed will do away with this inefficient procedure and be the means of substituting there for a better method One of the important contributions of the fracture committee to progress is the dissemination of knowledge of achievements along all lines of treatment A very important reason for establishing regional committees is to have available men in the different sections of the country to whom we may send our findings

At the Hospital Conferences stress was laid by me upon—

a The importance of the hospital management becoming familiar with results of the treatment of fractures by members of its staff Familiarity of the hospital management with the results of fracture treatment would mean that results must be determined

b A follow up is thus necessary The results will be good poor or bad This knowledge will help to determine whether the staff is efficient

c The organization of a social service is a prime essential for the hospital Such social service work need not be complicated and may be quite simple I dwell upon the function of medical social work on a fracture service such as

1 Interviews with all fracture patients admitted to wards (a) to discover any obstacles in patient's personal or family situation that would hamper continuity of treatment (b) to explain fully to patient what good end results mean in terms of the patient's part in carrying out after care plans and the limitations of skillful treatment in cases of severe injury (c) to explain clinic follow up what the doctor wants the patient to do and why

2 Medical social service to patients who need social treatment at this stage to assure their benefiting by the treatment

### I presented the following details

1 Complications of fractures familiar to the medical social worker (a) fear of hospital loneliness unwillingness to endure temporary discomfort for the sake of better end results, all tending toward discharge against advice (b) psychological reactions which undermine patient's self confidence and produce incapacity (c) financial distress due to cutting off of wages while family responsibilities continue (d) homelessness without savings (e) homes unsuitable for convalescent care (f) entire dependency due to complications of old age or chronic disease (g) inability to return to former occupation as result of the fracture

2 Social service work in the hospital may help to get satisfactory end results in fracture cases by (1) influencing attitudes of patient and family to secure co-operation with doctor's plan of treatment (b) studying patient's personality and securing pertinent social history to throw light on his reactions and to motivate treatment (c) adjusting the hospital routine to the needs of the helpless and easily discouraged patient and getting him regularly to the right doctor at the right time and place (d) obtaining adequate financial assistance to cover loss of wages readjusting hospital rates financing apparatus (e) planning after-care of patient in his home or elsewhere (ie convalescent home) arranging for service of visiting nurse when necessary (f) re-educating patient for work within his capacity, (g) acting as liaison officer between pa-

tient's private physician and the hospital staff in working out plan for after care

These social service notes have been practically worked out and have been found useful by the Social Service group of the Massachusetts General Hospital in Boston

During this trip some twenty regional committees were appointed

These small groups of men selected from those interested in fracture work will be the means of (1) maintaining local fracture interest, (2) conducting fracture clinics and meetings (3) organizing teaching demonstrations (4) keeping in touch with the general fracture committee, (5) receiving and locally broadcasting bulletins issued from time to time by the general committee, and (6) co-operating with future visiting delegations from the general fracture committee

In conclusion, it may be stated that my visit through the western states served definitely to secure a knowledge of fracture treatment by bringing into view present practice, by informing the profession of the work of the College through its fracture committee to improve treatment, by assembling interested individuals who may develop a mutual understanding of needs, by establishing groups to concern themselves with progress and the output of the Committee contacts by stimulating interest in fractures directly by personal appeal, by sympathetic personal approval or criticism of work in progress by assistance in establishing fracture service in the larger hospitals according to local conditions

Such contacts as are made by attendance on these clinical meetings if repeated with regularity will serve in a large measure gradually to improve fracture treatment

### REPORT OF DOCTOR BURTON J LEE REPRESENTING THE COMMITTEE ON THE TREATMENT OF MALIGNANT DISEASES WITH RADIUM AND X RAY

An opportunity was afforded me, as one of the clinicians participating in the sectional meetings to observe the activities of the College from an entirely new viewpoint and the reaction of surgeons and the public to the program provided I had had little appreciation of the extensive educational work which was being carried out by the College in connection with these sectional meetings nor the necessity for the organized effort in hospital standardization

In all the cities visited the medical staffs of hospitals attached great importance to the hospital standards set up by the College The conferences held by Dr MacFachern were always largely attended, as many as three hundred people being

present at one session. These meetings attracted doctors, hospital superintendents, members of the nursing staffs, social service workers and record clerks. The meetings were well conducted and many interesting demonstrations were held giving rise to subjects for discussion. This department of the College has done much to improve the quality of hospital service and make more effective the clinical and research work of the staffs. The insistence upon adequate and well kept records in standardized hospitals was repeatedly emphasized as well as the maintenance of the highest ethical standards. The necessity for staff conferences at regular intervals was stressed that the entire work of the staff might be reviewed and critically analyzed.

For many years, we have been convinced that the management of the cancer problem throughout this country, and in Canada, was helter skelter and everybody's business for in but few places was there any intensive focus upon the subject. In some of the larger cities, cancer institutes had already been gained through my association with the Memorial Hospital of New York during the past ten years. I knew that there were well organized institutions for the study and treatment of cancer and for research in this field, located in Montreal, Boston, Philadelphia, Baltimore, St. Louis, Minneapolis, Rochester, Minnesota, Atlanta, Buffalo and New York. There is also the Crocker Institute in New York City devoted entirely to the research phases of the problem. We, who have worked intensively in special cancer institutes, feel certain that the problem can be handled effectively only when a group of men unite to study the clinical and research aspects of the subject. I am convinced that no individual should depend solely upon himself in making a diagnosis of carcinoma, nor determine the treatment to be used. This is a task requiring a joint judgment of surgeons, pathologists, radiologists and internists. When such a group attempts a diagnosis, the bias of any individual is minimized and a more correct estimate of the case is made. Moreover, the learning of any individual toward a special type of treatment is carefully checked and in general the best line of therapy chosen for each particular patient. In such an institution the contact of the clinical group with laboratory research workers stimulates a scientific interest in the subject of cancer.

It was evident that in many of the cities which we might visit a cancer institute could not be organized. In these cities it seemed practicable to assemble groups of men, each group to contain several surgeons, a pathologist, a gynecologist, a

urologist, a radiologist, and a competent internist. These men would join together with the object of making better diagnosis upon cancer patients, to outline and carry out proper forms of therapy, and to encourage clinical research in this important field. Dr. Crowell told me that he had had this same idea in mind for some time and was in full accord with the proposed effort.

### *Method of Procedure*

The general plan of procedure in each city which we visited was as follows:

As soon as possible after our arrival, I saw the chairman of the local committee and asked him to select the men in the community best fitted to form a cancer group. I also requested him to choose a convenient time when Dr. Crowell and I might meet with these men and explain the necessity for such an organized effort. In the meantime, I made it my business to meet and become acquainted with the men in the community, visiting them in their hospitals and seeing some of the operative work which was being done. In every city which we visited, I saw in consultation with the members of the profession, numerous cases of cancer, the total number approximating one hundred. Many of these patients were seen after the evening meetings.

In the cities in which sectional meetings were held, namely, Phoenix, Los Angeles, Vancouver, Regina, Winnipeg, Minneapolis and Lincoln, I conducted a cancer clinic, presenting patients furnished by the doctors in the community. The plan followed was to have the doctor present the patient. Then I made a few brief comments upon the case from the standpoint of diagnosis and treatment, using the patient as a text to emphasize some important points. At one or two of the later clinics we were able to obtain pathological autopsy material and conduct, with the aid of pathologists present, a brief clinico-pathological conference. These clinics occupied, as a rule, but one hour, for it seemed best to make them short and concise, closing the clinic promptly. At practically all of the cities visited, I presented a paper with lantern slides upon "The Indications for Surgery and The Indications for Irradiation in the Treatment of Cancer," this paper being presented invariably within a thirty minute limit. In addition to these activities at several County Medical Society Meetings, I presented a paper entitled "A Clinical Index of Malignancy for Cancer of the Breast" with lantern slides, the talk consuming twenty minutes—but no more.

The public meetings held in the evening attracted large audiences on one occasion over two

thousand being present. Always an atmosphere of friendliness pervaded the meetings. The session began promptly at eight o'clock and closed at ten o'clock. There were seven or eight short addresses, giving a large amount of valuable information to the public concerning the preservation of health and the control of disease. This particular activity of the College has the highest educational value. The audience was informed as to the need of adequate hospitalization for their community, the meaning of the term "Standardized Hospitals" and the necessity for staffing the hospitals with competent ethical surgeons. Dr. Crowell emphasized the important advances in modern medicine, and at some of the meetings other papers of a similar sort were presented, setting forth in terms that the public could understand the accomplishments of medicine in recent decades. I gave a fifteen minute talk entitled "What Can You and I Do About Cancer?" I stressed the optimistic side of the subject by pointing out that many types of cancer are preventable and that early cancer in many instances, is curable.

The clinicians participating in the trip presented papers at the scientific sessions, gave practical clinics and addresses at the public meetings. Besides these activities, Dr. Crowell, of the department of clinical research, and I took the first steps in organizing clinical and research facilities throughout the country in behalf of cancer patients.

At the appointed hour Dr. Crowell and I held our conference with the men chosen and outlined briefly the necessity for cancer organization in their community. The plan was heartily received everywhere and there was unanimous accord that provision should be made for better care of patients afflicted with cancer.

The first step to be taken was the organization of a conference for consultation with members of the group on cancer patients: the presentation of end results, good and bad, and the exhibition of interesting pathological material. Special history forms prepared by our committee are to be furnished to the various cancer units, with the request that they return the completed histories to the American College of Surgeons. If nothing more than this were possible it was termed a cancer group.

In some cities additional diagnostic and therapeutic facilities were available, and it was feasible to organize an out patient clinic. Such an organization, we termed a cancer clinic.

If, in addition to the conference and the out patient clinic hospitalization a physical depart-

ment, and a research laboratory could be initiated a cancer institute was formed.

Organization was effected by election of a chairman, vice chairman, and secretary, nominations having been made in open meeting. It was agreed that additional men could be added to the temporary committees depending upon the needs of the community. Permanent organization is to be effected by the Board of Regents of the College at their annual meeting.

*San Diego, Cancer Clinic.* In San Diego, it seemed the psychological moment to start a cancer clinic. The group of men thought it was feasible to organize immediately for work, and to establish a weekly conference in the Out Patient Department, where cancer patients could be studied and treated.

A letter of March 18 just received from the secretary of the cancer clinic, shows the progress already made in San Diego.

You will no doubt be glad to know that the organization for the cancer work in San Diego is well advanced. We have formed a committee which is very representative and last Saturday and our first conference at the County Hospital reviewing eight diversified malignant cases. Everyone seems to be highly enthusiastic so that the future seems distinctly bright.

*Los Angeles.* The best plan here seemed to be the organization of two cancer clinics: one at the California Hospital and the second at the County Hospital. The material coming from these clinics would be valuable and furthermore a proper evaluation of Dr. Percy's work should be made by the College.

*Santa Barbara.* I left Los Angeles by motor on the evening of February 19, driving to Santa Barbara where I spent the night. The following day, we visited the Cottage Hospital, which seemed an excellent plant. I was much impressed at the entrance of the Hospital to see on a small mahogany desk close to the door the word "Hostess," which seemed a friendly greeting to a patient entering this institution. Considerable cancer research is being carried on in this hospital with a well equipped animal house.

*San Francisco, Cancer Institute.* In San Francisco we were delighted to find that a new cancer institute had just been organized. Money has been provided through the Board of Health Budget to carry on the work of the institute. Three men are to make a trip this spring to various cancer institutes to study methods and organization and to obtain, if possible, a full time director for the institute. Much is to be expected from their efforts, as the men are earnest and the whole medical background in San Francisco is

**healthy and refreshing** It is interesting that the San Francisco group had, themselves, made the decision to organize a cancer institute At both the University of California and Stanford Medical Schools, I had a pleasurable visit with the laboratory men and was impressed with the high type of research in both of these institutions It is planned to make the cancer institute a headquarters and collecting agency for cases of carcinoma for both the Stanford and University of California units

**Portland, Cancer Clinic** In this city we were pleased to find that a cancer clinic had already been organized at the Good Samaritan Hospital and had been in existence for one year The clinic is held every Monday morning in one of the top floors of the building in rooms assigned for these purposes and adjacent to a modern X ray plant covering diagnosis and therapy This group is earnest and considerable may be expected from it

**Vancouver** We met a representative group of men in Vancouver and had our usual talk with them There was an unwillingness to organize any cancer group in Vancouver without conference with the Vancouver Medical Society It was therefore decided that the representative of the American College of Surgeons in Vancouver should confer with the members of the Vancouver Medical Society on the matter and that we should communicate with him concerning the organization of the cancer group

**Winnipeg, Cancer Institute** Here we were able to gather together, in the Library of the Medical Arts Building a very unusual group of men including representative clinicians and physicists from the University Great interest was shown concerning the formation of a cancer institute It appeared feasible to establish a radium emanation plant through the co-operation of the Department of Physics of the University An informal vote was taken and it was decided that the Dean of the Medical School should name a committee to organize and carry on this work From the side of the American College of Surgeons, we promised that we would send them at the earliest possible moment a plan of organization for the conduct of a cancer institute in Winnipeg Much is to be expected from this city in the attempt at cancer organization for one could seldom meet a more earnest attractive group of professional men

**Minneapolis, Cancer Institute** Here a cancer institute has been in existence for the past three years The physical plant is excellent with adequate facilities for out patient work and an excellent X ray equipment and hospitalization is provided for upward of thirty patients

**Omaha, Cancer Group** Although Omaha was not on our schedule, I left Lincoln on March 16, early in the morning by train to Omaha There I presented a paper to the third and fourth year students of the University of Nebraska Medical School and also emphasized the necessity for careful anatomical training and refined surgical technique in the treatment of cancer Later, I addressed the group of medical men who meet weekly at the University Hospital repeating the paper which had been given to the students After this meeting, I met the men interested in the formation of a cancer group

Those present agreed that three vice chairmen should be chosen by the officers, one from each of the important hospitals in the city of Omaha

A report of such a trip could not be complete without a comment upon the type of surgery done in the cities visited Everywhere I saw well done surgery the operators showing a background of fundamental surgical knowledge and demonstrating over and over again the highest technical skill Few surgeons in the eastern part of the United States appreciate the expert surgery that is being done in all parts of the country

#### *Details Incident to Cancer Organization*

**Conferences** In each instance where an organization was effected, the men agreed to conduct a conference, preferably to be held each week At these conferences, cancer patients were to be presented by members of the group and also by other physicians in the city and adjacent country This will necessitate a careful history before presenting the patient and will make for better history taking The presentation should be followed by a frank discussion concerning the diagnosis and the proper treatment to be applied The cancer patient will, therefore, have the advantage of free consultation from members of the entire group Furthermore, the conference will furnish an opportunity for each man to see many of the cases of cancer occurring in the community and clinical experience in the field of cancer will be greatly augmented At the conference, follow up cases with good and bad results should be shown and the pathologist should present interesting operative and autopsy specimens of cancer material

**Records** Records of cancer patients coming to these clinics should be sent to the American College of Surgeons upon forms provided by the College Subsequent follow up records should be obtained for the College by sending, periodically to these clinics a request for further information Histories should be submitted of cases treated by



surgery and cauterization, as well as by X ray and radium

*Bulletins* In return for these records the College should send out at regular intervals to all these organized cancer units, bulletins of information on various subjects in the cancer field, much of which has been obtained from an analysis of the record cards of cancer patients. In this way a proper give and take between the cancer group and the American College of Surgeons will be provided.

*Out patient cancer clinics* Although it is impossible for many of the group to organize a bona fide out patient cancer clinic at present, this should be one of the ultimate objectives. Increasing numbers of interesting and early cases will present themselves and the activity of the groups will be very much extended. Eventually such out patient clinics should hold daily sessions.

*Hospitalization* As a complete institute is formed hospitalization must be provided for cancer patients under the control of those doing the work in the institute. If the institute is a part of a general hospital, the cancer patients should be segregated wherever possible.

*Cancer research* No cancer institute can be well rounded unless clinical and laboratory research are important features. Adequate, well equipped laboratories with a trained personnel, are essential. If the men lack interest in the research side of the cancer problem the most important part of their activity falls to the ground. These institutes and clinics should be encouraged by the American College of Surgeons to pursue research studies upon cancer.

*Department of physics* A cancer institute is incomplete without an organized department of physics controlled by a trained physicist with facilities for investigative work.

*Association of cancer institutes and clinics* The College should organize such an association with an annual round table conference held at the American College of Surgeons or in some other city, for discussion of the clinical and research problems of cancer.

#### REPORT OF ROBERT JOLLY, SUPERINTENDENT BAPTIST HOSPITAL, HOUSTON, TEXAS

It was recently my pleasure and profit, as a hospital superintendent, to make the American College of Surgeons tour of sectional meetings from Phoenix, Arizona to Lincoln Nebraska.

It was not the first tour of its sort I have made and therefore I cannot be accused of being unduly excited and thrilled by what I saw, heard and experienced. Without any exaggeration it is my opinion that these tours, planned and financed

by the American College of Surgeons are doing more for the trustees, superintendents, and personnel of the hospitals and, therefore, for the hospitals touched by the tours, than is any other agency in America. Only a small percentage of the 7,000 hospital superintendents will ever be able to attend any of the national conventions for hospital workers. This is true because of financial difficulties. To me it is providential that these groups of noted surgeons and hospital experts are sent over the country in these sectional meetings, bringing these wonderful opportunities within a reachable distance of those who ought to attend.

In one place a surgeon said to me "I am tired of going to these meetings, rehashing many of the things we have heard before with some few new things added." I said that I had observed that each time one of these meetings was held more and more people attended who had never attended before and these were becoming imbued with the Standardization doctrine and were passing it on to others. In fact in a number of places I asked for a lifting of hands to see how many were attending a meeting of that sort for the first time and it was astonishing to see the large number.

Of course, I am writing from, and of the hospital standpoint. I did not attend but one or two of the scientific meetings, but I talked with large numbers of the Fellows and the feeling everywhere was that Dr. Crowell with his scientific meetings, bringing Drs. Scudder, Lee, Kreuscher, Adson, Mayo, and others across the continent, was making a distinct contribution toward the improvement of surgery in all its branches.

At Phoenix we found the profession very much agitated by the course being pursued by the irregular and definite efforts being made to get the legislature to pass a bill which would protect the public from their machinations. At the public meeting Dr. Franklin H. Martin very frankly told of his efforts with the governor and legislature in behalf of the bill and urged the public to insist that their representatives take a proper stand.

I had the pleasure, with Dr. Lee of speaking at the Hiram Noonday Club and found this group of leading business men very much interested in the things we were advocating and was delighted to see many of them at the public meeting. This meeting was held in the Presbyterian church which was filled to overflowing and the sympathetic and the responsive audience inspired us all.

The hospital conferences were well attended and there was not a dry moment. The lack of

formality in these round table discussions makes it easy for all to present their problems and give their own views. At Phoenix as well as at the conferences in the other cities, the Catholic Sisters were interested and interesting participants and added much to the value of the meetings.

At Los Angeles every meeting, scientific, hospital, and public, was largely attended and I have never seen more enthusiasm exhibited. If I were to compare the results from the different cities we visited, Los Angeles would be at the top. Dr. Scudder, Dr. Lee and Father Moulinier were enthusiastically received and Dr. Martin was acclaimed not only as president of the American College of Surgeons but as its director general and the guiding genius of its inception and its progress.

One of the most enjoyable features of the stay in Los Angeles was the dinner given by the Medical Society.

The public meeting was in the Gold Room of the Biltmore hotel. Every seat was taken and many stood. Over 3,000 were in attendance. I was especially struck by the appearance of the audience. It was not only a most intelligent looking group but an especially well dressed one.

Many of those in the audience knew of the conflict raging between the irregulars and the medical profession and Dr. Martin in no uncertain terms announced the attitude of the College and the policy to be pursued in regard to hospitals which countenance the irregular. His statement was greeted by great applause much to the surprise of many. This meeting was an index to the feeling of the people.

Vancouver was ready and waiting for us and all the meetings went off with a bang. The scientific meetings were largely attended and on every hand I heard the most favorable expressions concerning the clinics and lectures.

It was a real homecoming for Dr. MacEachern for it was here that he spent eight years as superintendent of the Vancouver General Hospital. Everywhere we went he was given an ovation and it was a joy to see how highly he was regarded not only by the profession, but by citizens in every walk of life. I think everyone in Vancouver must know him. He not only put the Vancouver General on a pinnacle as a hospital but he made a place among the citizenry that no one can displace.

It was my privilege to speak at the Rotary and Kiwanis clubs and I found the members alert as to the hospital situation and eager to hear more about public health. Let me say here that wherever we mentioned the annual physical examination it was received with lively interest

and at the close of the meetings we were bombarded with questions as to the "how."

The public meeting was a revelation of the interest of the public as to health matters. Not only was every available seating space occupied in the hall but hundreds stood and other hundreds were compelled to go away for lack of space.

Our program lasted two hours and I did not see a single one of the hundreds who stood attempt to go out. This meeting together with all the other public meetings made me wish that the College would put on a year's campaign of public meetings in the centers of population. What a wonderful amount of good could be accomplished with one hundred public meetings in 1930.

We had a wonderful hospital conference at St. Paul's hospital and then again at the Vancouver General. The Sisters at the one and Dr. Bell at the other held back nothing that would contribute to the success of the meetings. They brought the nurses in uniform to the public meeting which added much not only to the interest but to the appearance there.

At Regina the meeting gathered momentum and the climax came at the public meeting when many stood and others were turned away.

Our hospital conferences were held in the General Hospital and the Gray Nuns where everything was done for our comfort and profit and the round tables sparkled with snappy questions and answers. A parting dinner was given the party by the Fellows of the College at which the good fellowship was continued.

Dr. MacEachern and I stopped at Brandon for one day where we inspected the General Hospital under the direction of Miss McLeod. The medical staff and board of directors were our hosts at dinner in the hospital and Dr. MacEachern met with the executive committee in closed session after the dinner.

Next day I arrived in Winnipeg where we had a public meeting at night in the Central Presbyterian church. Another packed house greeted us and gave us an enthusiastic hearing. I visited all of the hospitals of the city and was greatly impressed not only with their buildings and equipment but with the high class of work being done in them.

In Minneapolis I visited St. Mary's Asbury, St. Barnabas, Norwegian General and University hospitals. I found all of them with building programs and every one committed to the Standardization program. The first day's conferences were held as usual in the hotel, and the second day the conference was held in the morning.

surgery and cauterization as well as by X ray and radium

*Bulletins* In return for these records the College should send out at regular intervals, to all these organized cancer units bulletins of information on various subjects in the cancer field, much of which has been obtained from an analysis of the record cards of cancer patients. In this way a proper give and take between the cancer group and the American College of Surgeons will be provided.

*Out patient cancer clinics* Although it is impossible for many of the group to organize a bona fide out patient cancer clinic at present, this should be one of the ultimate objectives. Increasing numbers of interesting and early cases will present themselves and the activity of the groups will be very much extended. Eventually such out patient clinics should hold daily sessions.

*Hospitalization* As a complete institute is formed hospitalization must be provided for cancer patients under the control of those doing the work in the institute. If the institute is a part of a general hospital, the cancer patients should be segregated wherever possible.

*Cancer research* No cancer institute can be well rounded unless clinical and laboratory research are important features. Adequate, well equipped laboratories with a trained personnel are essential. If the men lack interest in the research side of the cancer problem the most important part of their activity falls to the ground. These institutes and clinics should be encouraged by the American College of Surgeons to pursue research studies upon cancer.

*Department of physics* A cancer institute is incomplete without an organized department of physics, controlled by a trained physicist with facilities for investigative work.

*Association of cancer institutes and clinics* The College should organize such an association with an annual round table conference held at the American College of Surgeons, or in some other city, for discussion of the clinical and research problems of cancer.

#### REPORT OF ROBERT JOLLY SUPERINTENDENT, BAPTIST HOSPITAL, HOUSTON, TEXAS

It was recently my pleasure and profit, as a hospital superintendent to make the American College of Surgeons tour of sectional meetings from Phoenix Arizona, to Lincoln Nebraska.

It was not the first tour of its sort I have made and therefore, I cannot be accused of being unduly excited and thrilled by what I saw, heard and experienced. Without any exaggeration it is my opinion that these tours, planned and financed

by the American College of Surgeons are doing more for the trustees, superintendents, and personnel of the hospitals, and, therefore, for the hospitals touched by the tours, than is any other agency in America. Only a small percentage of the 7,000 hospital superintendents will ever be able to attend any of the national conventions for hospital workers. This is true because of financial difficulties. To me it is providential that these groups of noted surgeons and hospital experts are sent over the country in these sectional meetings, bringing these wonderful opportunities within a reachable distance of those who ought to attend.

In one place a surgeon said to me 'I am tired of going to these meetings rehashing many of the things we have heard before with some few new things added.' I said that I had observed that each time one of these meetings was held more and more people attended who had never attended before and these were becoming imbued with the Standardization doctrine and were passing it on to others. In fact in a number of places I asked for a lifting of hands to see how many were attending a meeting of that sort for the first time and it was astonishing to see the large number.

Of course I am writing from, and of the hospital standpoint. I did not attend but one or two of the scientific meetings, but I talked with large numbers of the Fellows and the feeling everywhere was that Dr. Crowell with his scientific meetings bringing Drs. Scudder, Lee, Kreuscher, Adson, Mayo and others across the continent was making a distinct contribution toward the improvement of surgery in all its branches.

At Phoenix we found the profession very much agitated by the course being pursued by the irregulars and definite efforts being made to get the legislature to pass a bill which would protect the public from their machinations. At the public meeting Dr. Franklin H. Martin very frankly told of his efforts with the governor and legislature in behalf of the bill and urged the public to insist that their representatives take a proper stand.

I had the pleasure with Dr. Lee of speaking at the Hiram Noonday Club and found this group of leading business men very much interested in the things we were advocating and was delighted to see many of them at the public meeting. This meeting was held in the Presbyterian church, which was filled to overflowing and the sympathetic and the responsive audience inspired us all.

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CHICAGO surgeons and the administrative heads of Chicago's medical institutions are keenly interested to provide a complete showing of the clinical surgical activities of this great medical center during the nineteenth annual Clinical Congress of the American College of Surgeons which opens on Monday, October 14, continuing for five days up to and including Friday, October 18. A preliminary program of the clinics and demonstrations to be given during the Congress will be found in the following pages. The program as here published is merely an outline of what the clinicians of Chicago expect to present at this year's session, as the several hospital schedules are to be revised and amplified during the weeks preceding the Congress in order that the details of the clinical work to be demonstrated may be presented more completely. It will be noted that the program provides for operative clinics and demonstrations beginning at 2 o'clock on Monday, October 14, and for each morning and afternoon of the following four days. The real program will be issued daily during the Congress (1) in the form of bulletins to be posted on bulletin boards at headquarters each afternoon thereby presenting an accurate and detailed schedule of the clinics and demonstrations to be given at each of the hospitals the following day, and (2) in the form of printed bulletins to be distributed each morning.

In recent years Chicago's clinical facilities have been largely increased in keeping with the growth of the city. Since 1913, when the last session of the Clinical Congress was held in Chicago, a number of new hospitals have been built and some

of the older institutions have been remodeled and enlarged. With increased clinical facilities in the hospitals and a notable increase in hotel facilities, it will be possible to accommodate comfortably a much larger number of visiting surgeons at this year's meeting than at any previous session in Chicago. The Committee on Arrangements and Chicago's surgeons as a group are actively interested in maintaining Chicago's popularity as a clinical center. At the offices of the College an unusually large number of advance registrations has been received indicating a wide interest in the plans for this year's meeting.

At this year's Congress special attention is to be devoted to the demonstration of modern methods in the treatment of fractures. A series of special fracture clinics is being planned to be given daily at the Cook County Hospital by members of the surgical staff of that institution. Similar clinics are being arranged at many other of the larger hospitals. In addition to the fracture clinics given by Chicago surgeons, a special series of clinics and demonstrations is being arranged under the supervision of the College Committee on Fractures to be given at the Cook County Hospital on Tuesday and Wednesday afternoons. At these particular clinics several of the members of this committee living outside of Chicago have been asked to participate and will give demonstrations of special methods used in the more difficult fracture cases.

A series of dry clinics to be given by outstanding American surgeons at the Stevens Hotel on Tuesday and Wednesday afternoons forms an important feature of the clinical program. Among

in the General Hospital and in the afternoon in St. Mary's. At the places we visited the conferences in the hospitals assumed an even more personal touch than in the hotel, for in the hospitals we had members of the personnel in uniform each to take a place on the platform where every one was free to cross-examine the witness and then debate the pro and con of any subject pertaining to that particular line of service. The meetings were more like the gathering of a big family or clan for stimulation of thought and exchange of ideas for the benefit of said group.

Because of the location of the State University in that city all scientific subjects and discussions took on added interest and values and the scientific men in our party were kept on the jump both physically and mentally to meet the demand upon them.

The public meeting at the Strand Theater was largely attended and the public and the news papers were exceedingly kind in their expression of appreciation.

Our last meeting at Lincoln from the scientific and hospital standpoint was above the average, but because of the counter attractions the attendance at the public meeting was the smallest of the series.

I was particularly struck with the well balanced programs prepared for the public meetings. No one could get tired for it was arranged that each alternate fifteen minute address should be illustrated, and it is a well known fact that people do not tire when they are interested or when they see pictures. I made it a point to get in the doorway at the close of the meetings to hear the com-

ments of those passing out. Invariably the comments were flattering and would be very encouraging to the Regents of the College could they have heard a small part of what I heard.

I shall never forget the first sectional meeting of the American College of Surgeons I attended directly after I became a hospital superintendent. I was 'green,' but grasping for knowledge. I had no idea what the meeting was for nor what I might learn by attending. But when two days had passed all too quickly and I had time to catch my breath after hearing so many valuable things about my job that I had never dreamed of, I found I had caught a vision and an inspiration to have not an ordinary hospital, but an extraordinary one where the patient would be protected and provided with the best. That vision and inspiration have grown since then and as I have sat in meetings on this recent tour and have seen how the hospital folk have eagerly drunk in every word and asked for more and yet more and have complained because the meetings were too short, my sympathy has gone out to them for I have traveled that same road and am yet traveling it.

I do not believe anyone but a hospital superintendent can realize what this program is meaning to our hospital fraternity and in behalf of the fraternity everywhere I urge the Regents of the College not only to keep up the program, but to enlarge it and intensify it.

Since returning home I have answered over fifty requests for information and help from those who sat in our meetings. Surely this is indicative of the interest I am glad to have had a humble part in arousing it.

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The ophthalmologists and otolaryngologists of Chicago are planning a highly attractive clinical program of broad scope that will include operative clinics and demonstrations covering all phases of surgical work in these specialties. In addition to the clinical program, the officers of the Chicago Ophthalmological and Chicago Laryngological societies have planned for a joint session with dinner on Wednesday evening at the Stevens Hotel. Among the speakers at that session will be Mr. Herbert Tilley, of London, one of the outstanding otolaryngologists of Great Britain. A complete program for this session will appear in a later issue.

Leaders in industry, education and labor, together with representatives of indemnity companies, surgeons and hospital administrators have been asked to attend and contribute to a conference on traumatic surgery planned for Friday morning and afternoon. At this conference the Chairman of the Committee on Traumatic Surgery will report on the work of the committee in recent years and outline future activities in this highly important part of the work of the College. The program includes an open forum for the discussion of various phases of the subject and presentation of formal papers by outstanding men. A detailed program is in course of preparation and will be published at an early date.

General headquarters for the Congress will be established at the Stevens Hotel, located on Michigan Avenue between Seventh and Eighth Streets, where the grand ballroom, three smaller ballrooms, and many other large rooms have been reserved for the exclusive use of the Congress for the scientific meetings, hospital conferences, registration and ticket bureaus, bulletin boards, scientific exhibits, executive offices, technical exhibition, etc. All of the evening meetings are to be held in the grand ballroom; the same room being used for the hospital conference on Monday, the annual meeting on Thursday afternoon and the conference on traumatic surgery on Friday.

#### EVENING MEETINGS

The Executive Committee of the Clinical Congress is preparing programs for a series of five evening meetings, a preliminary outline of which will be found in the following pages. At the Presidential Meeting on Monday evening to be held in the grand ballroom of the Stevens Hotel, the president elect, Major General Merritte W.

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#### HOSPITAL CONFERENCE

For the annual hospital conference, which opens at 9:30 on Monday morning in the grand ballroom of the Stevens Hotel, an interesting program of broad scope has been prepared. Papers, discussions, round table conferences and demonstrations that have to do with the every-day problems of the boards of trustees, medical staffs and hospital executives will occupy the hours of both morning and afternoon of the four days Monday to Thursday inclusive. Friday will be devoted to the inspection of Chicago hospitals. The keynote of this year's conference is "better care of the patient" and the promotion of closer relations among the several groups that have to do with the care of the patient.

At the opening session on Monday forenoon the address of welcome will be given by Dr. Arnold H. Kegel, commissioner of health for Chicago. Distinguished guests and representatives of national organizations will be introduced by the president, Surgeon General Merritte W. Ireland. At this session the official report on the progress of hospital standardization with the list of approved hospitals for 1929 will be presented by the director general, Dr. Franklin H. Martin.

Among the important features of the program for the conference will be the practical demonstration of a model staff conference conducted by one of the local hospitals in connection with

which there will be a general discussion of the entire subject of staff conferences. Other important features of the program for the conference include: A symposium on the control and elimination of infections in hospitals; an open forum on administrative problems relating to the care of the patient; an address on the health inventory in standardized hospitals by Dr. Franklin H. Martin; a joint session with the Association of Record Librarians on Wednesday morning at which the papers and discussions will deal with increasing the efficiency of case records. Dr. M. T. MacEachern, associate director of the College in charge of hospital activities, will discuss hospital problems of the present and future.

The hospital conference is planned to interest not only surgeons but hospital trustees, executives and personnel generally, and an invitation is extended to all persons who are interested in hospital activities to attend this year's Congress. Those who will attend are invited to avail themselves of other activities of the Congress, especially to attend the Presidential Meeting Monday evening, and the Convocation Friday evening.

#### REDUCED RAILWAY FARES

The railways of the United States and Canada have authorized reduced fares on account of the Chicago session of the Clinical Congress so that the total fare for the round trip will be one and one half the ordinary first class one way fare. To take advantage of the reduced rates it is necessary to pay the full one way fare to Chicago, procuring from the ticket agent when purchasing ticket a "convention certificate" which certificate is to be deposited at headquarters for the use of a special agent of the railways. Upon presentation of a valid certificate to the ticket agent in Chicago not later than October 30th a ticket for the return journey by the same route as traveled to Chicago may be purchased at one half the one way fare.

In the eastern, central, and southern states and eastern provinces of Canada, tickets may be purchased between October 10th and 18th, in south western and western states between October 9th and 17th, and in the far western states and western provinces of Canada between October 6th and 14th. The return journey from Chicago must be begun not later than October 30th.

The reduction in fares does not apply to Pullman fares, nor to excess fares charged for passage on certain trains. Local railroad ticket agents will supply detailed information with regard to dates of sale, rates, routes, etc. Stop-overs on both the going and return journeys may be had within certain limits.

Full fare must be paid from starting point to Chicago, and it is essential that a "convention certificate" be obtained from the agent from whom the ticket is purchased. These certificates are to be signed by the general manager of the Clinical Congress and vised by a special railroad agent in Chicago during the meeting. No reduction in railroad fares can be secured except in compliance with the regulations outlined and within the dates specified. It is important to note that the return trip must be made by the same route as that used to Chicago and that the certificate must be deposited at headquarters during the meeting and return ticket purchased and used not later than October 30th.

It will be noted that the arrangement outlined above, extending the return limit to October 30th, allows for an additional twelve days following the close of the Clinical Congress thus providing an opportunity for visiting other clinical centers in the middle west.

An exception to the above arrangement is to be noted in the case of persons traveling from points in certain far western states and British Columbia who will be able to purchase round trip summer excursion tickets which will be on sale up to and including September 30th with a final return limit of October 31st. The summer excursion fare is somewhat lower than the convention fare mentioned above, but is available only in certain of the far western states and British Columbia. Tickets sold at summer excursion rates permit traveling to Chicago via direct route and returning via another direct route, with liberal stop over privileges.

#### LIMITED ATTENDANCE

Attendance at the Chicago session will be limited to a number that can be comfortably accommodated at the clinics, the limit of attendance being based upon the result of a survey of the amphitheatres, operating rooms, and laboratories in the hospitals and medical schools to determine their capacity for accommodating visitors. Under this plan it will be necessary for those who wish to attend to register in advance.

Attendance at all clinics and demonstrations will be controlled by means of special clinic tickets, which plan provides an efficient means for the distribution of the visiting surgeons among the several clinics, and insures against over crowding as the number of tickets issued for any clinic will be limited to the capacity of the room in which that clinic will be given. Clinic tickets will be distributed each morning and may be reserved late on the previous day.



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## PRELIMINARY PROGRAM FOR EVENING MEETINGS

*Presidential Meeting—Monday 8 15 P M —Grand Ballroom Stevens Hotel*

Address of Welcome HERMAN L KRETSCHMER M D , Chicago, Chairman of Committee on Arrangements

Address of Retiring President FRANKLIN H MARTIN, M D Chicago

Introduction of Foreign Guests

Inaugural Address Surgery in the Medical Department of the United States Army MAJOR GENERAL MERRITT W IRELAND, Washington

The John B Murphy Oration in Surgery Some Principles in Abdominal Surgery PROFESSOR D P D WILLIE Edinburgh, Scotland

*Tuesday, 8 15 P M —Grand Ballroom, Stevens Hotel*

FRANK H LAHEY, M D , Boston Hyperthyroidism Associated with Cardiac Disorders

Discussion H M RICHTER, M D , and OSCAR NADEAU, M D Chicago

EDWARD W ARCHIBALD, M D Montreal Some Phases of Thoracic Surgery

Discussion CARL A HEDBLUM, M D and RALPH B BETTMAN M D , Chicago

WALTMAN WALTERS, M D Rochester, Minn A Method of Reducing the Incidence of Fatal Post operative Pulmonary Embolism

Discussion EDWIN M MILLER M D Chicago

*Wednesday, 8 15 P M —Grand Ballroom Stevens Hotel*

JAMES HEYMAN M D Stockholm Sweden Radiology as a Complete or Partial Substitute for Surgery in the Treatment of Cancer of the Female Pelvic Organs

Discussion ARTHUR H CURTIS M D , and HENRY SCHMITZ M D , Chicago

WILLIAM B HOLDEN, M D Portland, Oregon The Surgical Treatment of Intestinal Obstruction

Discussion FREDERIC A BCSLLY M D JOHN A WOLFER M D and LESTER R DRAGSTEDT, M D , Chicago

CHARLES L SCUDDER M D Boston Oration on Fractures

*Thursday 8 15 P M —Grand Ballroom Stevens Hotel*

A W ADSON M D Rochester Minn Surgical Indications for Sympathetic Ganglionectomy and Trunk Resection in the Treatment of Chronic Arthritis (In collaboration with LEONARD G ROWNTREE, M D )

Discussion LOYAL DAVIS M D , and LEWIS J POLLOCK M D Chicago

Symposium Pernicious Anæmia

GEORGE H WHIPPLE M D , Rochester N Y Physiological Background of the Treatment of Pernicious Anæmia by Diet Factors

C C STURGIS, M D Ann Arbor, Mich The Treatment of Pernicious Anæmia by Liver Feeding

WILLIAM P MURPHY M D Boston Newer Developments of Liver Feeding in Cases of Anæmia, Liver Feeding in Diseases of the Liver

Discussion CHARLES A ELLIOTT M D Chicago

*Comocation—Friday 8 15 P M —Grand Ballroom Stevens Hotel*

Conferring of Honorary Fellowships

Presentation of Candidates for Fellowship Class of 1929

Presidential Address The Medical Department of the United States Army MAJOR GENERAL MERRITT W IRELAND Washington

Fellowship Address DR GLENN FRANK President of the University of Wisconsin, Madison

## REGISTRATION FEE

A registration fee of \$5.00 is required of each surgeon attending the annual Clinical Congress, such fees providing the funds with which to meet the expenses of the meeting. To each surgeon registering in advance a formal receipt for the registration fee is issued, which receipt is to be exchanged for a general admission card at headquarters. This card which is non transferable, must be presented to secure clinic tickets and admission to the evening meetings.

## CHICAGO HOTELS AND THEIR RATES

In recent years a number of fine large hotels have been built in Chicago, among which is the Stevens with its 3000 guest rooms. Ample first class hotel facilities are available, many of the hotels being located within short walking distance of the headquarters hotel.

	MU m m	
	Rate with Bath	Rate with Room
Auditorium Michigan Ave and Congress St	\$3.50	\$5.00
Belmont 3100 Sheridan Road	4.00	5.00
Bismarck 175 W Randolph St	3.50	5.00
Blackstone Michigan Ave and East 7th St	5.00	10.00
Chicago Beach Hyde Park Blvd at the Lake	5.00	5.00
Congress Michigan Ave and Congress St	4.00	6.00
Drake Michigan Ave and Walton Place	5.00	6.00
Edgewater Beach 5349 Sheridan Road	4.00	6.00
Fort Dearborn Van Buren and LaSalle Sts	1.95	3.00
Great Northern Jackson Blvd and Dearborn	3.50	4.50
Knickerbocker Walton Place and Michigan	3.00	5.00
Lake Shore Drive 181 Lake Shore Drive	5.00	7.00
LaSalle LaSalle and Madison Sts	3.00	4.50
Morrison Clark and Madison Sts	2.50	5.00
Palmer Monroe and State Sts	4.00	1.00
Parkway 211 Lincoln Park West	3.00	5.00
Pearson St Clair and Pearson Sts	3.50	5.00
Sherman Clark and Randolph Sts	3.00	4.00
Stevens Michigan Ave and 11th St	3.50	6.00
Webster Lincoln Park West at Webster Ave	3.00	5.00

## CLINICAL DEMONSTRATIONS

*Tuesday 2 P M—Grand Ballroom, Stevens Hotel*

J M T FINNEY, M D Baltimore Surgery of the stomach  
 BURTON J LEE, M D, New York Tumors of the breast  
 CHARLES H MAYO, M D Rochester The general problems of cancer  
 F W RANKIN M D and C W MAYO M D Rochester Cancer of the small intestine

*Wednesday 2 P M—Grand Ballroom Stevens Hotel*

GEORGE W CRILE M D Cleveland Influence of the thyroid and of the adrenals in the production and treatment of peptic ulcer  
 WALTER E DANDY, M D Baltimore Brain surgery  
 JOHN B DEAEVER M D, Philadelphia Abdominal surgery

## MERCY HOSPITAL

## Monday

- R S BERGHOFF—2 Differential diagnosis of chest diseases  
 JOSEPH LAIBF—2 Urologic surgery the relation of urology to gynecology  
 P H KREUSCHER—2 Congenital dislocations of the hip injection treatment of varicose veins

## Tuesday

- L D MOOREHEAD—9 Surgery of the thyroid gland Exophthalmic goiter toxic adenoma parenchymatous goiter and mixed type of goiter  
 J F GOLDEN—9 Abdominal surgery  
 P C JACOBSON—9 Fractures in industrial surgery  
 J B O'DONOLGHEE—2 Tumors of breast their surgical significance, clinical significance of reverse peristalsis of the upper intestinal tract particularly in reference to gastrojejunal anastomosis reaction of different classes of thyroid cases to surgery and treatment of some unusual complications  
 C L MARTIN—2 Polyps of the rectum and sigmoid tuberculous ulcers of the sigmoid and rectum

## Wednesday

- C F SAWYER—9 Pancreatitis—acute subacute and chronic types of intestinal obstruction  
 M I MCGUIRE—9 Treatment of diseases of the gall bladder and bile ducts carcinoma of the colon  
 J L KELLEY—9 The acute abdomen  
 HENRY SCHMITZ—2 Early diagnosis and treatment of uterine and mammary cancers Diagnosis and treatment of sterility due to blocked uterine tubes  
 M C MULLEN—2 Totemias of pregnancy

## Thursday

- P H KREUSCHER—9 Treatment of advanced scoliosis fractures involving the knee joint fractures of the hip  
 F L PIERCE—9 Fracture clinic  
 F M DRENNAN L E GARRISON and C F SAWYER—2 Joint discussion on duodenal pathology with presentation of cases and the results of some experimental work consideration of esophageal stenosis by Dr Drennan  
 M MANDEL—2 Pernicious anemia

## Friday

- HENRY SCHMITZ—9 Gynecological surgery  
 GEORGE GRIFFIN—9 Gastro intestinal surgery  
 D CLARIDGE—9 Dislocation of internal semilunar cartilage  
 W S BARNES—2 Gynecological clinic  
 W J LICKETT—2 Fascial suture in the repair of hernia  
 A V PARTIELLO—2 Closed aseptic gastro intestinal anastomosis  
 B B BEESON—2 Dermatological conditions which may become surgical

## UNITED STATES VETERAN'S HOSPITAL

(Edward Hines Jr Hospital Hines Ill)

## Thursday

- CARL A HEDBLOM—9 Operations Thoracoplasty (two cases) phrenicoceles  
 PHILIP H KRIEGER—1 30 Operation for chronic osteomyelitis  
 ROBERT O JUTTER—2 30 Spinal fusion  
 JOHN S COULTER—3 30 Demonstration in physical therapy

## PRESBYTERIAN HOSPITAL

## Tuesday

- A D BEVAN and associates—9 General surgical operations  
 A D BEVAN DR GATEWOOD and R C BROWN—9 Gall bladder surgery  
 HERMAN L KRETSCHMER—9 Urological surgery  
 K H HERBST—9 Urological surgery  
 V C DAVIS—9 General surgical operations  
 CARL DAVIS—9 General surgical operations  
 N SPROAT HEANEY CAREY CULBERTSON A E KANTER E D ALLEN and C P BAUER—9 Gynecological and obstetrical clinics  
 W C THOMAS—10 30 Blood chemistry and postoperative care  
 A D BEVAN DR DAVIS and V C DAVIS—Surgery of the large bowel  
 A H MONTGOMERY—1 Intussusception

## Wednesday

- A D BEVAN and associates—9 General surgical operations  
 HERMAN L KRETSCHMER—9 Urological surgery  
 N SPROAT HEANEY CAREY CULBERTSON A I KANTER F D ALLEN and C P BAUER—9 Gynecological and obstetrical clinics  
 WILBUR POST—10 30 Medical preparation of poor surgical risks for surgery  
 KELLOGG SPEED—11 General surgical operations knee joint cases  
 E MILLER—9 General surgical operations  
 A D BEVAN DR DAVIS E M MILLER, and DR LORING—11 Surgery of the thyroid  
 ISABELLE HERBST—11 40 Anesthesia in goiter surgery

## Thursday

- A D BEVAN and associates—9 General surgical operations  
 HERMAN L KRETSCHMER—9 Urological surgery  
 R H HERBST—9 Urological surgery  
 V C DAVIS—9 General surgical operations  
 KELLOGG SPEED—9 Bone surgery  
 L M MILLER—9 Posterior dislocation of the shoulder  
 A H PARMELEE—9 Diagnosis of acute osteomyelitis  
 V C DAVIS—9 Regeneration of bone in osteomyelitis  
 R C WOODYATT—9 Iperation of diabetics for surgery  
 GEORGE F DICK—9 Cryopelias  
 PETER BASSETT and W J LOTTIS—9 Charcot joints  
 A H MONTGOMERY—9 Treatment of burns  
 N SPROAT HEANEY CAREY CULBERTSON A F KANTER F D ALLEN and C P BAUER—9 Gynecological and obstetrical clinics  
 H A OBERHELMAN—11 Surgical pathology

## Friday

- A D BEVAN and associates—9 General surgical operations  
 A D BEVAN DR GATEWOOD R C BROWN, D P ABBOTT and C G GRULLE—9 Surgery of the stomach  
 HERMAN L KRETSCHMER—9 Urological clinic  
 CARL DAVIS—9 General surgical operations  
 N SPROAT HEANEY CAREY CULBERTSON A E KANTER E D ALLEN and C P BAUER—9 Gynecological and obstetrical clinics  
 E E IRONS—10 30 Relation of focal infection to surgery  
 DR GATEWOOD—11 Subphrenic abscess  
 FREDERICK MOOREHEAD—11 20 Surgery of the mouth and face

## PRELIMINARY CLINICAL PROGRAM

## GENERAL SURGERY, GYNÉCOLOGY, OBSTETRICS, UROLOGY, ORTHOPEDICS

## WESLEY MEMORIAL HOSPITAL

## Monday

M T GOLDSTINE—2 Hysterectomy vaginal plastics

## Tuesday

G DE TAKATS—9 Varicose veins spinal anaesthesia

thyroidectomy local anaesthesia

GUY S VAN ALSTYNE—9 General surgery

LOYAL DAVIS—2 Brain surgery

## Wednesday

R W McNEALY—9 Hernias and blood vessel surgery

ALLEN B KANAVAL—9 General surgery

JOHN A WOLFER—9 Duodenal stasis and periduodenitis.

P B MACNOLSON and WILLIAM A HENDRICKS—2 Plastic on hip spinal fusion

## Thursday

ELUCENE B PERRY—9 Cystoplasties and kidney surgery

O S I WLIK—10 Hysterectomy and ovarian trans plantation

ALLEN B KANAVAL—9 General surgery

V D LESTINASSE—2 Genito urinary surgery

C J DeBERE—4 Rectal surgery

## Friday

R W McNEALY—9 General surgery

MICHAEL MASON—10 Dupuytren's contraction

J J GILL—10 Obstetrical surgery pathological obstetrics

M C ERLUCK—2 Hysterectomy ovarian cysts

P B MACNOLSON and WILLIAM A HENDRICKS—2 Plastic on hip spinal fusion

## RAVENSWOOD HOSPITAL

## Monday

G W GREEN—2 Gallstone clinic

G N BUSSEY—2 Abdominal hysterectomy fibroids.

G DE TARNOWSKY—2 Hemorrhagic colitis

## Tuesday

C A BUSWELL—9 Carcinoma of the cervix uteri.

D B POND—9 Fracture clinic

R F DYER—9 Fallopian tube visualization with 'ipiodol

W F GROSVENOR C C RENTRO and F W ROHR—2 Obstetrical conference

## Wednesday

E B WILLIAMS—9 Abdominal hysterectomy fibroids

P J SARM—9 Abdominal wall incisions based on physiologic grounds

F LOV NAIOWSKI—9 Hepatic abscess

## Thursday

L WILDER—9 Goutic cases

E B MUELLER—9 Treatment of burns

W F GROSVENOR C C RENTRO and F W ROHR—2

Obstetrical conference

G DE TARNOWSKY—9 Ruptures of urinary bladder

## Friday

G W GREEN—9 Surgical clinic

A G SCHROEDER—9 Surgical clinic.

## COOK COUNTY HOSPITAL

## Monday

F H FALLS—2 Operative obstetrics

SUMNER L KOCH—2 Surgery of the hand general surgery

## Tuesday

R W McNEALY—9 Blood vessel surgery

A E KANTER—9 Operative gynecology

W R CUBBINS—9 Ward walk in fracture ward

E L CORNELL—9 Complications of pregnancy and labor

H JACKSON—10 Injuries of the brain

J R HARGER—10 Acute osteomyelitis

E M MILLER—10 Toxic thyroid disease in children purpura hemorrhagica

D C STRAUSS—11 Surgery of the thyroid

KELLOGG SPEED—2 Tumors of bone fractures of carpal bones

GEORGE DE TARNOWSKY—2 Rupture of the bladder

E J LEWIS—2 Sliding hernia

J F GREENHILL—2 Operative gynecology

## Wednesday

HARRY CULVER—9 Genito urinary surgery

W R CUBBINS—9 Round table discussion on fractures

H SCHMITZ—9 Inflammation of the pelvic organs carcinoma of the pelvic organs

F J JIRKA—10 General surgery

P H KRELSCHER—10 Osteomyelitis congenital deformities arthroplasty of hip arthroplasty of elbow

J R BUCHSINDER—2 Surgery of the thyroid

F H FALLS—2 Operative obstetrics

J P FITZGERALD—2 Obstetrical complications

H C ROLNICK—2 Intravenous anaesthesia in urologic surgery

SUMNER L KOCH—2 Surgery of the hand general surgery

## Thursday

R W McNEALY—9 Blood vessel surgery

J R HARGER—10 Acute osteomyelitis

E M MILLER—10 Fractures about the elbow in children

H JACKSON—10 Operations under spinal anaesthesia

KARL MEYER—10 Gastric surgery

W R CUBBINS—2 Fractures of femur

D S HILLIS—2 Obstetrics

A. F. LASH—2 Treatment of puerperal infection

## Friday

G L APPELBACH—9 Surgical complication of diabetes.

A E KANTER—9 Operative gynecology

E L CORNELL—9 Complications of pregnancy and labor

F A DYAS—10 Thyroid disease, carcinoma of the breast.

V C DAVID—10 Carcinoma of large bowel

GEORGE DE TARNOWSKY—2 General surgery

## ALEXIAN BROTHERS HOSPITAL

E. W. WHITE EDWARD JESS A WOODHEAD C O KOTCH

ALF HOLM and J GLASSER—9 daily Genito-urinary clinic

M L HARRIS AUGUST ZIMMERMAN and DANIEL MURPHY

—9 daily General surgical clinic

RALPH WHEELER WILLIAM SWIFT FRANK BAYLOR and

A. I. STEVENS—9 daily Fracture clinic.

## JOHN B. MURPHY HOSPITAL

## Monday

- HENRY R. HENRY—Surgery of bones and joints arthrodesis of the knee  
 WILLIAM GEHL—Renal function test urological surgery  
 F. H. KAMPP—Hallux valgus

## Tuesday

- M. J. IRLCFF—Fracture clinic  
 GUSTAV BRANDLE—Operative treatment of cranial injuries  
 A. C. SLINDE—Conservative surgery for hydronephrosis  
 S. S. McNEIL—Plastic operations on hand and face

## Wednesday

- ARNOLD H. KEGEL—Thyroid clinic operation and demonstration of cases  
 E. J. YOUNG—Operative treatment of old fracture of the os calcis  
 JAMES LARKIN—Radium treatment of carcinoma of cervix

## Thursday

- WILLIAM GEHL—Two stage suprapubic prostatectomy  
 JOSEPH CUNNINGHAM—Management of the eclamptic patient  
 JOHN WALLNER—Diagnosis and management of sterility  
 J. WILSON CRIMES—Surgical treatment of pulmonary tuberculosis  
 L. C. McDERMOTT—Cesarean section

## Friday

- A. C. CARVY—Surgical treatment of ulcers of the stomach  
 J. M. HAMILTON—Surgery of the nervous system  
 F. O. BOWE—Tendon grafting  
 JAMES J. MCGLENN—Carcinoma of the colon and sigmoid  
 J. F. LEO—Surgery of the gall bladder and common duct

## UNIVERSITY HOSPITAL

## Tuesday

- ADOLPH KRAFT—9 Suppuration about the diaphragm  
 GEORGE M. LANDAU—10 Pathological aspects of the lung from a roentgenological standpoint  
 MAX MEYEROVITZ—11 Surgical conditions of Meckel's diverticulum

## Wednesday

- HARRY SINGER—9 Demonstration of gastro intestinal specimens  
 KARL A. MEYER—10 Gastro intestinal surgery

## Thursday

- ARTHUR H. CONLEY—9 Calcium and phosphorus metabolism in fractures  
 CHARLES DAVISON—10 Surgery of autogenous bone transplants

## Friday

- O. H. ROHRBACK—9 Surgical obstetrics  
 MARSHALL DAVISON—10 Surgery of undescended testes

## RUSH MEDICAL COLLEGE

## Tuesday

- CARL DAVIS—11 Surgical clinic

## Wednesday

- N. S. HEAFY—11 Gynecological clinic

## Thursday

- A. D. BEVAN—11 Surgical clinic

## Friday

- CARL DAVIS—11 Surgical clinic

PASSAVANT MEMORIAL HOSPITAL—NORTH  
WESTERN UNIVERSITY MEDICAL SCHOOL

## Monday

- CHARLES A. ELLIOTT and associate—2 Symposium on diseases of the liver and bile passage Cirrhosis of the liver by Paul Starr surgery in jaundiced patients by H. M. Richter the gall bladder hormone by A. C. Ivy the spinal cord pathway of afferent impulses from the gall bladder by J. T. Hart and R. C. Crain

## Tuesday

- H. M. RICHTER—9 Cholecystectomy cholelithiasis  
 LOYAL DAVIS—9 Trigeminal neuralgia  
 S. W. RAYSON I. J. POLLOCK and LOYAL DAVIS—2 Symposium on the diagnosis and surgical treatment of diseases affecting muscle function

## Wednesday

- ALLEN B. KANAVEL—9 Thyroid surgery  
 J. R. BUCHBINDER—9 Thyroid surgery  
 JAMES C. CARR CHARLES A. ELLIOTT H. M. RICHTER and ALLEN B. KANAVEL—2 Symposium on diseases of the thyroid gland

## Thursday

- H. M. RICHTER—9 Thyroid surgery  
 LOYAL DAVIS—9 Brain tumor  
 ALLEN B. KANAVEL SUMNER L. KOCH MICHAEL L. MASON and C. G. SHEARON—2 Symposium on surgery of the hand

## Friday

- ALLEN B. KANAVEL—9 Dupuytren's contraction  
 SUMNER L. KOCH and MICHAEL L. MASON—9 Tendon transplantation  
 (Note—Morning clinics at Passavant Memorial Hospital afternoon clinics at Northwestern University Medical School)

## COLUMBUS HOSPITAL

## Monday

- D. A. ORTH—Abdominal surgery

## Tuesday

- FRED MUELLER—2 Orthopedic surgery

## Wednesday

- M. J. SEIFERT and D. KUPP—9 Gastric surgery

## Thursday

- Drs. WILLIAM and LEVA SADLER—9 Gynecological surgery

NORTH CHICAGO HOSPITAL  
(At Grant Hospital)

## Tuesday

- FREDERICK HARVEY—9 Fracture clinic with special reference to fractures about the ankle and elbow

## Wednesday

- CARL BECK—9 Plastic surgery of the hands and fingers

## Thursday

- FREDERICK HARVEY—9 Thyroid clinic

## Friday

- CARL BECK—9 Hypoplasias

## MICHAEL REESE HOSPITAL

## Tuesday

- ALFRED A. STRAUSS Stomach resection for gastric and duodenal ulcer common duct duodenal anastomosis for recurrent gall stones  
 HARRY JACKSON Bone tumors and osteomyelitis  
 D C STRAUSS Thyroid surgery  
 IRVING S. KOLL Pyelotomy for tone nephrectomy for kidney tumor urethral plastics  
 JULIUS F. LACKNER Abdominal hysterectomy inter position operation rectovaginal fistula  
 W H RUBOVITS Obstetrical demonstration of forceps version and complete suture episiotomy

## Wednesday

- ALFRED A. STRAUSS Gastric resection for ulcer and a complete colectomy and blood transfusion  
 GEORGE L. DAVENPORT General surgery surgery of the central nervous system  
 RALPH B. BETTMAN Surgery of the chest  
 J S LISFENSTADT Undescended testes and prostatectomy  
 CHARLES M. JACOBS and DANIEL LEVENTHAL Orthopedic surgery  
 L E FRANKENTHAL Gynecological operations

## Thursday

- ALFRED A. STRAUSS Stomach resection for gastric and duodenal ulcer and carcinoma of the colon  
 GEORGE L. DAVENPORT General surgery  
 D C STRAUSS Gall bladder surgery  
 JOSEPH L. BAER Complete perineal laceration ovarian tumor and pelvic inflammation.  
 IRVING STEIN Obstetrical demonstration low cervical cesarean under local anesthesia.  
 CUSTAV KOLISCHER Bladder tumors.  
 HARRY C. ROLNICK Prostatectomy

## Friday

- ALFRED A. STRAUSS Gastric resection for carcinoma and gall bladder surgery  
 GEORGE BETTMAN General surgery of malignant tumors  
 HELIODOR SCHILLER General surgery treatment of extensive carbuncle  
 HARRY KATZ Diverticulum of bladder  
 ALFRED F. JONES Spinal anesthesia and prostatectomy  
 JULIUS F. LACKNER and W H RUBOVITS Sturmdorf Wertheim operation for carcinoma of the cervix plastic repair  
 JOSEPH L. BAER and IRVING STEIN Prolapse vaginal hysterectomy fibroids occiput posterior

## CHICAGO LYING-IN HOSPITAL

## Monday

- JOSEPH B. DE LEE—2 Motion pictures of laparotomy chelotomy

## Tuesday

- D A. HORNER and L. E. NADELHOFFER—9 Obstetrical clinic  
 A R LAPHAM—2 Obstetrical clinic.

## Wednesday

- J P GREENHILL and M E DAVIS—9 Obstetrical clinic

## Thursday

- E L CORNELL and M P URNES—9 Obstetrical clinic

## Friday

- J H BLOOMFIELD and H BUXBAUM—9 Obstetrical clinic

## ST JOSEPH'S HOSPITAL

## Tuesday

- FRANK DAVID and C J DeBERE—9 Rectal surgery  
 W H G LOGAN—9 Oral surgery  
 CHARLES M. McKENNA—9 Genito-urinary surgery  
 HUGH McKENNA OSCAR OPNER DAVID FITZGERALD and GEORGE FITZGERALD—9 General surgery  
 CHARLES SCHOTT—9 Results of Rammstedt operation for pyloric stenosis in infants

## Wednesday

- FRANK DAVID and C J DeBERE—9 Rectal surgery  
 F B McCARTY E P CARROLL and JOHN BOLAND—9 General surgery  
 W F GROSVENOR, H BUXBAUM, L. W. MARTIN T J O'DONOGHUE F W ROHR and G COTTS—11 Gynecology

## Thursday

- FRANK DAVID and C J DeBERE—9 Rectal surgery  
 W H G LOGAN—9 Oral surgery  
 CHARLES M. McKENNA—9 Genito-urinary surgery  
 HUGH McKENNA OSCAR OPNER DAVID FITZGERALD and GEORGE FITZGERALD—9 General surgery  
 L E HINES—9 Demonstration of laboratory work as applied to surgery

## Friday

- F B McCARTY E P CARROLL and JOHN BOLAND—9 General surgery  
 W F GROSVENOR H BUXBAUM L. W. MARTIN T J O'DONOGHUE F W ROHR and G COTTS—11 Gynecology

## SPECIAL FRACTURE CLINICS

(At Cook County Hospital Arranged by the Committee on the Treatment of Fractures)

## Tuesday

- CHARLES L. SCUDDER Boston (Chairman of Committee)—2 The aims and work of the Fracture Committee  
 M S HENDERSON Rochester Minn—2 30 Non union after fracture massive bone graft lantern slide demonstration and patients  
 W C CAMPBELL, Memphis Tenn—3 30 Reduction by closed manipulation of fracture of the shaft of the femur two cases  
 P D WILSON Boston—4 15 Operation Subastragular arthrodesis for fracture of the os calcis

## Wednesday

- FRED C. COTTON, Boston—2 Artificial impaction for fracture of neck of femur two cases  
 WILLIAM O'NEIL SHERMAN Pittsburgh—2 4, Plating for fracture of shaft of femur  
 E L ELIASOV Philadelphia—3 30 Pathologic fractures.  
 COLONEL W F KELLER Washington—4 Old fracture dislocation at the shoulder

## ST LUKE'S HOSPITAL

- L L. McARTHUR S W McARTHUR H E. JONES C A. HYDEBLOM SAMUEL PLUMMER and W B FISK—9 daily General surgical clinics  
 LOUIS SCHMIDT and HARRY CULVER—9 daily Genito-urinary clinics  
 E L RYERSON, PHILIP LEWIN R O RITTER F A CHANDLER and H B THOMAS—9 daily Orthopedic clinics  
 ARTHUR H. CURTIS and H O JONES—2, daily Gynecological clinics.

## ALBERT MERRITT BILLINGS HOSPITAL

*Monday*

LESTER DRAGSTEDT—Abdominal surgery, intestinal obstruction

*Tuesday*

PERCIVAL BAILEY—9 Surgery of the spinal cord  
D B PREMISTER L DRAGSTEDT G M CURTIS and C B HIGGINS—9 Surgical operations

*Wednesday*

D B PREMISTER—9 Surgery of bones and joints  
P BAILEY G M CURTIS I DRAGSTEDT and C B HIGGINS—9 Surgical operations

*Thursday*

G M CURTIS—9 Surgical operations  
D B PREMISTER P BAILEY I DRAGSTEDT, and C B HIGGINS—9 Surgical operations

*Friday*

C B HIGGINS—9 Genito urinary operations  
D B PREMISTER P BAILEY G M CURTIS and L DRAGSTEDT—9 Surgical operations

## LAKE VIEW HOSPITAL

*Tuesday*

H P SAUNDERS—9 Surgery of the gall bladder demonstration of cases  
B C CORBLES—2 Bladder tumors

*Wednesday*

ANDRE L STAPLER—2 Thyroidectomies toxic adenoma with spinal block hysterectomies fibroids with spinal anesthesia

*Thursday*

JOHN W BIRK—9 Obstetrical clinic, presentation of pathological cases  
WALTER S SIEWERTH—2 Surgical correction of pathology of female genitalia

*Friday*

C I WYNKOOP—9 Surgery of the abdomen, demonstration of cases

## EVANGELICAL DEACONESS HOSPITAL

*Tuesday*

EDWARD M HEACOCK—9 Operative treatment of uterine fibroids

*Wednesday*

A J SCHOENBERG—9 Carcinoma of the cervix uteri  
F O BOWE—2 Placenta previa and management of its complications

*Thursday*

C V BACHELLE—9 Operations for ulcer of the stomach and duodenum.  
L H FRIDRICH—2 Management of the complications of gonorrhea

*Friday*

PAUL F MORF—9 Gall bladder disease and its operative treatment  
ELMER W MOSLEY—2 Cesarean section in contracted pelvis

## RESEARCH AND EDUCATIONAL HOSPITAL

*Monday*

H B THOMAS—2 Orthopedic surgery

*Tuesday*

CARL A HEDBLOM—10 Thoracic surgery

*Wednesday*

JEROME R HEAD—10 Neurological surgery  
F H FALLS—2 Gynecology and obstetrics

*Thursday*

J D KOUCKY—10 General surgery

*Friday*

LINDON SEID—9 Thyroid surgery  
LOUIS SCHULTZ—10 Oral surgery  
F H FALLS—2 Gynecology and obstetrics

## POST GRADUATE HOSPITAL

*Tuesday*

L GLASSMANN—9 Prolapse of the uterus  
W SCHAAKE—10 Colles fracture

*Wednesday*

LEO ZIMMERMAN—10 Vascular diseases of the extremities  
W A N DORLAND—2 Repair of penneum

*Thursday*

H L MEYERS—9 Hysterectomy  
R W HARDON—10 Injection treatment of varicose veins  
EMIL RIES—2 Enterocoele vaginalis

*Friday*

EMIL RIES—10 Precancerous lesions of cervix uteri  
M MABEE—2 Treatment of leucorrhea

## ILLINOIS MASONIC HOSPITAL

*Tuesday*

JOHN R HARGER—9 Infection of upper abdomen  
ROBERT H HAYES—10 Infection of the lungs  
B H HIGGINS—11 Arthritis

*Wednesday*

GILBERT FITZPATRICK—9 Obstetrical surgery  
WILLIAM H GILMORE—10 Pelvic trauma  
JOHN P SPRAGUE—11 Orthopedic clinic

*Thursday*

HUGH MACLEACHIE—9 Gastro intestinal surgery  
EDWARD A WHITE—10 Genito urinary clinic  
BAYARD HOLMES—11 Myocarditis and surgery

*Friday*

MORRIS BLATT—11 Thymus disease

## GRANT HOSPITAL

*Tuesday*

A G FRYE—9 General surgical clinic  
D A ZIMMERMAN—11 General surgical clinic

*Thursday*

D A ZIMMERMAN—11 General surgical clinic

*Friday*

S COOMBS—9 General surgical clinic



## CHICAGO MEMORIAL HOSPITAL

*Monday*

VANCE RAWSON—2 Cardiovascular disease and surgery  
CHARLES J. DRUECK—3 Diverticulitis

*Tuesday*

ARTHUR T. MAHLE—9 Management of the thyroid patient  
PETER S. CLARK—9 Surgery of the thyroid  
JULIA C. STRAWN—2 Surgical gynecology  
JAMES E. FITZGERALD and M. RUTH MCGUIRE—3 30 Surgical obstetrics

*Wednesday*

BENNETT R. PARKER—9 Surgery of the gall bladder and bile tract  
J. W. PARKER—9 Hydronephrosis and hypernephroma  
FRANK WRIGHT and ALBERT ZUNER—10 Demonstration of humoral colloids relation of the colloids of the plasma to surgical problems  
ROBERT A. MELENDY—2 Empyema and allied conditions  
GEORGE L. BROOKS and ROBERT A. MELENDY—4 Surgery in diabetics

*Thursday*

CHARLES E. KAHLE—9 Surgery of the stomach and duodenum  
PAUL M. CLIVER—2 Fractures general management operation treatment and results  
CHARLES J. DRUECK—3 Unusual rectal fistulas  
M. L. WEINSTEIN—4 Gall bladder surgery under local anesthesia

*Friday*

LAWRENCE L. ISEMAN—9 The cancer problem

## WASHINGTON PARK COMMUNITY HOSPITAL

*Tuesday*

C. C. CLARK—9 Thyroid operation carcinoma of breast  
H. H. COX—9 Cholecystectomy, hemorrhoids  
Y. JORANSON—2 Blood transfusion spinal anesthesia  
F. P. HAMMOND—2 Hernia recurrent and ventral management of fracture about ankle

*Wednesday*

S. C. HOGAN—9 Gastric resection gall bladder surgery  
L. B. BELL—9 Cholecystectomy posterior gastroenterostomy  
C. C. COX—2 Hysterectomy carcinoma of breast thyroid  
C. C. CLARK—2 Hernia gastroenterostomy

*Thursday*

F. P. HAMMOND—9 Osteomyelitis empyema  
Y. JORANSON—9 Goiter gastroenterostomy  
L. B. BELL—2 Appendectomy hemorrhoidectomy  
S. C. HOGAN—2 Hysterectomy thyroid

## ST ANTHONY DE PADUA HOSPITAL

*Tuesday*

LAWRENCE RYAN, FRED EHRMANN, STEPHEN DONLON and JOSEPH ZABOTSKY—9 General surgical operations  
OTTO J. HIRSA—9 Genito-urinary surgery  
L. S. TICHY—9 X ray demonstration

*Thursday*

JOHN SPRAFKA, FRED OLLENTINE, FRANK JIRKA and RALPH CUPLER—9 General surgical operations  
HARRY SMIJEL—9 Genito urinary surgery  
MAX WEISKOPF—9 Obstetrics  
L. S. TICHY—9 X ray demonstration

## WOMEN AND CHILDREN'S HOSPITAL

*Tuesday*

Drs. PARSON and TRUE—9 Lapidol visualization of the uterine and tubal cavities  
PEARL M. STETLER—9 Watkins Wertheim operation  
CONSTANCE O. BRITTS—9 General surgical operations  
HELEN FLYNN—2 Dry clinic Treatment of carcinoma of the uterus breast and intestines Flynn method  
MARY E. WILLIAMS—2 Dry clinic Treatment of carcinoma of the cervix and uterus with radium  
MARGARIT H. ALSTED—2 Dry clinic Cardiograms and heart cases

*Wednesday*

MARIE ORTMAYER—9 Cystoscopic demonstrations  
ANNA BLOUNT—9 General surgical operations  
RACHELLE YARROS—2 Social hygiene in relation to obstetrics and gynecology  
GIRY OTIS—2 X ray demonstration  
JOHANNA HETMAN—2 Pediatric cases  
CLARA OCHES—2 Twilight sleep demonstration obstetrical cases

*Thursday*

JOSEPHINE MCCOLLUM and FRANCES E. HAINES—9 Demonstration of various types of anesthesia methylene nitrous oxide chloroform and ether  
ALICE CONKLIN—9 Hernia operations  
BERTHA BUSH—9 General surgical operations  
BERTHA VAN HOOSEN—2 Dry clinic General surgical cases  
WALBURGA L. KACTIN—2 Twilight sleep demonstration, obstetrical cases

*Friday*

PEARL M. STETLER—9 Thyroidectomy  
JULIA STROVG—9 Gynecological operations  
EFFIE L. LOBBELL—9 Studies in sterility with demonstration of cases  
LENA K. SÄDLER—9 Laparotomy  
ALICE CONKLIN—9 Hysterectomy for fibroid

## WEST SIDE HOSPITAL

*Tuesday*

C. R. G. FORRESTER and H. C. LYMAN—9 Fracture clinic, local anesthesia in reduction of fractures  
E. W. BROWN—11 Surgery of gastric and duodenal ulcers  
P. C. GEORGIN—9 Abdominal surgery management of intestinal obstruction

*Wednesday*

J. S. NAGEL—9 Prostatectomies demonstration of functional tests in renal surgery neoplasms of the kidney  
G. F. THOMPSON—9 Surgery of the bile tracts  
S. G. WEST—11 Vaginal hysterectomy vaginal route in pelvic surgery

*Thursday*

C. R. FORRESTER and H. C. LYMAN—9 Results of air insufflation in treatment of sequela of cranial injuries operative treatment of recent and old bone and joint injuries  
C. C. O'BRYEN—11 Goiter clinic  
A. M. HARVEY and J. H. CHIVERS—2 Industrial surgery

*Friday*

A. N. CLAGGETT—9 Radium in the treatment of malignant disease demonstration of cases  
C. G. SCHWESTZER—11 Genito urinary surgery Cystoscopies renal catheterization and X ray demonstration treatment of hydronephrosis

## FRANCES E WILLARD HOSPITAL

*Monday*

- F G DYAS—Surgical treatment of ulcer of the stomach and duodenum  
 J S VAGEL—Surgery of hydronephrosis  
 J W CARR—Management of the eclamptic patient  
 A H C GOLDFINE—Radium treatment of carcinoma of the cervix  
 GEORGE J RUKSTINAT—Pathological demonstration

*Tuesday*

- VICTOR L SCHRAGER—Surgery of the abdomen  
 F A MACKOWIAK—Treatment of Pott's fracture  
 H CULVER—Urological surgery

*Wednesday*

- FRANK D MOORE—Surgery of the gall bladder operations and demonstration of cases  
 JOHN R HARGER—Tendon grafting and suturing  
 M S COFFLER—Renal function test in urological surgery  
 LUDWIG HEKTOEN—Pathological demonstration

*Thursday*

- A E STEWART and MILTON OCHOA—Operative treatment of cranial injuries  
 OTIS M WALTER and S BIEZES—Thyroid clinic  
 E S BLANE—Roentgenology

*Friday*

- J P JAROS—Thyroid clinic  
 G F THOMPSON—Fracture clinic  
 J A VALENTINE—Emergency surgery

## MOUNT SINAI HOSPITAL

*Tuesday*

- V L SCHRAGER—Abdominal surgery with special reference to interpretation and management of surgical risks

*Wednesday*

- I L BISHOP—Abdominal surgery  
 A E KANTER—Vaginal plastics hysterectomies

*Thursday*

- V L SCHRAGER—Abdominal surgery with special reference to interpretation and management of surgical risks  
 L HANDELMAN—General surgical operations

*Friday*

- J MORA and B A WILLIS—Gouters fractures  
 M BERNSTEIN—Orthopedic surgery Synovectomies of knee spinal fusion

## CHILDREN'S MEMORIAL HOSPITAL

*Monday*

- JOHN A GRAHAM—The acute abdomen

*Tuesday*

- JAY IRELAND—The treatment of empyema in children

*Wednesday*

- FREDERICK B MOOREHEAD—Cleft lip and cleft palate cartilage transplants for the correction of facial deformities

*Thursday*

- ALBERT H MONTGOMERY—Pyloric stenosis and intussusception general surgery of children

## AUGUSTANA HOSPITAL

*Tuesday*

- NELSON M PERCY—Thyroid clinic, general abdominal surgery spinal anesthesia  
 R J ODEN—General surgery

*Wednesday*

- O E NADFAU—General urological surgery  
 J W NIZUM—General surgery  
 L H OCHSNER—General surgery  
 D W CRILE—Orthopedic surgery

*Thursday*

- NELSON M PERCY—Thyroid clinic general abdominal surgery spinal anesthesia  
 P J ODEN—General surgery

*Friday*

- O E NADFAU—General urological surgery  
 J W NIZUM—General surgery  
 L H OCHSNER—General surgery  
 D W CRILE—Orthopedic surgery

## ILLINOIS CENTRAL HOSPITAL

*Tuesday*

- C H PHIFER—Dry clinic Abdominal surgery  
 FARIS CHESLEY—Medical aspects of acute abdomen

*Wednesday*

- W T HARSH—Thyroid clinic  
 L SLOAN—Medical aspects of toxic goiter  
 A H BAUGHER—Pathology of toxic goiter

*Thursday*

- HUGH MACKENZIE—Dry clinic general surgery  
 J C DELPRAT—Dry clinic general surgery  
 BEVERIDGE MOORE—Orthopedic surgery  
 WILLIAM CULPEPPER—X ray demonstration of pathology of Paget's disease

*Friday*

- W T HARSH and C C GUY—Dry clinic General surgery  
 WILLIAM HEWITT—Dry clinic Gynecology and obstetrics

## JACKSON PARK HOSPITAL

*Tuesday*

- ARRIE BAMBERGER A HENNING and associates—General surgery  
 S B MACLEOD—Traumatic surgery

*Wednesday*

- ARRIE BAMBERGER A HENNING and associates—General surgery

*Thursday*

- ARRIE BAMBERGER A HENNING, and associates—General surgery

*Friday*

- S B MACLEOD—Traumatic surgery

## GARFIELD PARK HOSPITAL

*Monday*

- J M BRIGER—2 Thyroid clinic operations and demonstration of cases  
 J R HARGER—2 Bone transplant, nerve and tendon suture  
 CARL BAKER—3 Diagnosis and management of stenility  
 radium treatment of carcinoma of the cervix  
 P S SCHMIDT—3 Pathological presentations

*Tuesday*

- FRANK D MOORE—9 Surgery of the upper abdomen  
 THEODORE TEIKEN—9 The medical aspects of the abdominal case  
 F L BROWN—2 Gall bladder surgery

*Wednesday*

- C C ROGERS—9 Operative treatment of cranial injuries  
 L I MACDIARMID—9 Surgery of the abdomen  
 VINCENT J O CONOR—2 Two-stage suprapubic prostatectomy  
 BEVERIDGE MOORE—2 Orthopedic surgery

*Thursday*

- VICTOR SCHRAGER—2 Surgical treatment of ulcer of the stomach  
 C WELDY—2 Surgery of the gall bladder  
 R H GOOD—2 Thoracic surgery

*Friday*

- G C FOLSER—9 Surgery of the thyroid  
 H L BAKER—9 Abdominal surgery  
 DR. DAHLE—9 Roentgenology

## SHRINERS HOSPITAL

*Monday*

- B H MOORE—2 Ward visit demonstration of apparatus in use.

*Tuesday*

- B H MOORE—9 Orthopedic operations use of ethylene anesthesia for children  
 MR. DREHER—2 Demonstration of braces and special apparatus

*Wednesday*

- B H MOORE and associates—2 Demonstration of plaster technique

*Thursday*

- B H MOORE—9 Orthopedic operations.  
 B H MOORE—2 Moving pictures

*Friday*

- B H MOORE—9 X ray demonstration of unusual conditions  
 B H MOORE—2 Results in orthopedic cases

## LUTHERAN MEMORIAL HOSPITAL

*Tuesday*

- CHARLES F STOTZ—9 General surgical clinic

*Wednesday*

- ARTHUR G FREY—9 General surgical clinic

*Thursday*

- CHARLES F STOTZ—9 General surgical clinic

*Friday*

- ARTHUR G FREY—9 General surgical clinic.

## SOUTH SHORE HOSPITAL

*Monday*

- FREDRICK RAHE—2 General surgical clinic  
 ETHELBERT LUTTON—3 General surgical clinic

*Tuesday*

- HUGH MACKECHNIE—9 General surgical clinic.  
 LOUIS D SMITH—11 Genito-urinary surgery  
 MARTIN MERBITZ—2 General surgical clinic.

*Wednesday*

- GUY VAN ALSTYNE—9 General surgical clinic  
 GEORGE G O BRIEN—11 General surgical clinic  
 EDMOND PROBY—2 General surgical clinic

*Thursday*

- WELLER VAN HOOK—9 General surgical clinic  
 AXEL WERELIUS—10 30 General surgical clinic  
 EDWARD MASTERTON—2 General surgical clinic

*Friday*

- FRANK MEAD—9 General surgical clinic  
 PAUL ROSBOROUGH—10 General surgical clinic.  
 FRANK MURPHY—11 Fracture clinic  
 LESLIE BLACKWOOD—2 General surgical clinic

## TRAUMATIC SURGERY CLINICS

(In the offices of the Medical Director of the Lumbermen's Mutual Casualty Co 4750 Sheridan Road)

*Monday*

- FRED J COTTON, Boston—2 Treatment of ununited fractures  
 J H SHORTELL, Boston—3 Treatment of fractures of the tibia  
 PAUL B MAGNUSON—3 30 Fractures extent of permanent disability

*Tuesday*

- DENNIS R W CRILE—2 Ruptured brachial plexus results of musculo-spiral nerve suture  
 WILLIAM M HARSHA and G V PONTIUS—3 Trauma to abdomen removal of spleen carcinoma of stomach  
 L P KACHN—4 Report of 74 cases of trauma to abdomen with immediate operation in 27 extent of permanent disability

*Wednesday*

- PHILIP H KRELSCHER—2 Knee joint injuries  
 EDWIN W RYERSON—3 Back injuries extent of permanent disability

*Thursday*

- SIDNEY WALKER—9 30 Traumatic eye cases.  
 LOYAL DAVIS—10 30 Skull fractures  
 LEROY THOMPSON—11 30 Traumatic eye cases

## MUNICIPAL TUBERCULOSIS SANITARIUM

*Thursday*

- CARL A. HEDBLUM—9 30 Surgery of the chest in tuberculosis operative clinic and demonstration of end results

*Friday*

- CHARLES M McKENNA—9 30 Tuberculosis of the kidney operative clinic and demonstration of pathologic types of renal tuberculosis  
 BENJAMIN GOLDBERG and associates—2 Special measures in the general care of surgical tuberculosis.

## SURGERY OF THE EYE, EAR, NOSE, AND THROAT

## COOK COUNTY HOSPITAL

*Monday*

JAMES P. FITZGERALD—3 Fundus clinic

*Tuesday*

WILLIAM F. MONCRIEF—10 Diagnostic and operative eye clinic

THOMAS J. GALLOWAY—10 Diathermy and malignancies of the mouth and throat

CHARLES F. YERGER—2 Ophthalmoscopic and surgical clinic

*Wednesday*

JAMES P. FITZGERALD—2 Ophthalmoscopic and surgical clinic

S. SALLINGER and S. PEARLMAN—2 Diagnostic clinic nasal plastic surgery

*Thursday*

GEORGE W. BOOT—9 Bronchoscopic clinic

CHARLES F. YERGER—2 Ophthalmoscopic and surgical clinic

JAMES P. FITZGERALD—3 Fundus clinic

*Friday*

JAMES P. FITZGERALD—2 Ophthalmoscopic and surgical clinic

## NORTHWESTERN UNIVERSITY MEDICAL SCHOOL

*Monday*

L. A. SHIFFER and E. E. DILLON Chronic suppurative otitis media treated with zinc ionization

JOHN DELPH Endoscopy

*Tuesday*

C. F. BOOKWALTER Demonstration of intranasal tear sac operation

*Wednesday*

OTIS MACLAY Sinus work

WILLIAM JUICE Demonstration of plastic flap used in radical mastoid operation

*Thursday*

CHARLES B. YOUNGER Atrophic rhinitis

*Friday*

R. D. RUSSELL Demonstration of endolymphatic sac and valve

ELLISON L. ROSS Vestibular reaction as affected by drugs

## RUSH MEDICAL COLLEGE

*Monday*

WILLIAM G. REEDER—3 Ophthalmological clinic

*Tuesday*

CARLE B. FOWLER—3 Ophthalmological clinic

*Wednesday*

T. D. ALLEN—2 Ophthalmological clinic

*Thursday*

WILLIAM G. REEDER—3 Ophthalmological clinic

*Friday*

BERTHA KLEIN—3 Ophthalmological clinic

## RESEARCH AND EDUCATIONAL HOSPITAL

*Monday*

FRANCIS L. LEDERER, JOHN J. THEOBALD, and OSCAR VAN ALVEA—2 Otolaryngological clinic

*Tuesday*

HALLARD BEARD—9 Surgery of squint, tucking and tenotomy

NATHAN SCHNECK—10 Otolaryngological clinic

SHERMAN SHAPIRO and ARTHUR J. COOMBS—2 Otolaryngological clinic

FRANCIS L. LEDERER—2 Otolaryngological operations

*Wednesday*

I. G. SPIESMAN—10 Otolaryngological clinic

FRANCIS L. LEDERER, WALTER H. THEOBALD, and JOHN J. THEOBALD—2 Otolaryngological clinic

*Thursday*

GEORGE S. LIVINGSTON—10 Otolaryngological clinic

SHERMAN SHAPIRO and ARTHUR J. COOMBS—2 Otolaryngological clinic

JOHN J. THEOBALD—2 Otolaryngological operations

*Friday*

MAX L. FOLK and SALL C. GREENWALD—9 Plastic operations on the eyelids

J. HARNED—10 Otolaryngological clinic

FRANCIS L. LEDERER—2 Otolaryngological clinic

## MICHAEL REFSE HOSPITAL

*Monday*

M. L. FOLK—2 Diagnosis and treatment of intus

*Tuesday*

SAMUEL J. MEYER—2 Operations for glaucoma

*Wednesday*

ROBERT VON DER HEYDT—2 Slit lamp microscopy of the living eye

*Thursday*

S. C. GREENWALD—2 Operations for strabismus

*Friday*

ROBERT VON DER HEYDT—2 Photography of the anterior segment of the eye

## ILLINOIS CENTRAL HOSPITAL

*Tuesday*

J. H. McLAUGHLIN—9 Ear, nose and throat clinic

H. J. SMITH—9 Emergency surgery of the eye industrial injuries

*Wednesday*

J. H. McLAUGHLIN—9 Ear, nose and throat operative clinic

H. J. SMITH—9 Emergency surgery of the eye industrial injuries

*Thursday*

J. H. McLAUGHLIN—9 Ear, nose and throat clinic

H. J. SMITH—9 Emergency surgery of the eye industrial injuries

*Friday*

J. H. McLAUGHLIN—9 Ear, nose and throat operative clinic

H. J. SMITH—9 Emergency surgery of the eye industrial injuries

## ST BERNARD'S HOSPITAL

*Monday*

WILLIAM TUSTEIN—2 Goutier clinic  
G M CUSHING—2 Gall bladder clinic.

*Tuesday*

WILLIAM HECTOR—9 Surgical clinic  
L B DONKLE—9 Surgical clinic  
CHESTER GUY—2 Laboratory demonstration.  
J A PARKER—2 Surgical clinic

*Wednesday*

J B HAEBERLIN—9 Surgical clinic.  
EMIL RACH—2 Obstetrical clinic  
B C CLISWAY—2 Radium cases

*Thursday*

J T MEYER—9 Surgical clinic  
W H BOHART—9 Industrial surgery  
J G FROST—2 Fracture clinic

## HLNROTIN MEMORIAL HOSPITAL

*Tuesday*

CHANNING W BARRETT—9 Gynecological clinic

*Wednesday*

WILLIAM M THOMPSON—2 Management of abdominal  
and pelvic adhesions

## LUTHERAN DEACONESS HOSPITAL

*Tuesday*

JOHN D KOUCKY—9 General surgical clinic operations  
and demonstration of cases  
LINDON SEED—9 Thyroid clinic, operations and demon-  
stration of cases  
GEORGE H SCHROEDER—9 General surgical clinic oper-  
ations and demonstration of cases

*Thursday*

JOHN D KOUCKY—9 General surgical clinic, operations  
and demonstration of cases  
LINDON SEED—9 Thyroid clinic operations and demon-  
stration of cases.  
GEORGE H SCHROEDER—9 General surgical clinic oper-  
ations and demonstration of cases

## WASHINGTON BOULEVARD HOSPITAL

*Tuesday*

ARTHUR R. METZ—9 Fracture clinic.

*Wednesday*

VINCENT J O'CONNOR—9 Urological clinic.

*Thursday*

PAUL C. FOX—9 Gynecological clinic

## ST JOSEPH'S HOSPITAL

J. HOLINGER, ALSTIN A. HAYDEN, E. W. GARDNER, T. E. BLOMBERG, R. H. HENDERSON, and H. A. RAMSER—9 daily Tuesday to Friday inclusive. Operative clinics and demonstrations in the departments of otolaryngology and ophthalmology in collaboration with WILLIAM H. PURMISTEK, F. O. FREDRICKSON, and I. ELAND SHAVER of the department of internal medicine. CHARLES SCHOTT, GUSTAVE KAMPMEIER, MAURICE BLATT, and T. P. SALTIEL of the department of pediatrics. L. A. HIVES of the department of pathology and E. W. JENKINSON of the department of radiology.

Pharynx and larynx—Senile tonsillectomy, case histories with results, sutures in the tonsil fossa for control of hemorrhage, wax molds for graphically illustrating and recording conformation of nasopharynx and posterior nasal choanae, direct laryngoscopy.

Accessory nasal sinus disease—Incidence in adults, children and infants, presentation of case histories and results, lipiodol and percussion and auscultation as a diagnostic aid.

Tear sac disease—External and internal nasal operations. Nasal fractures—Diagnosis and treatment, photographs and casts for graphic records.

Ear—Demonstration of audiometers (by courtesy of Graybar Electric Co.) for group and individual hearing tests, indications for operation in acute mastoiditis, case histories, Pohlmann's stapedius muscle exercise and results.

J. HOLINGER—12 daily. Demonstration of microscopic and macroscopic temporal bone specimens.

Moving pictures, lantern slides and chalk talks will be used to illustrate certain features of the above program.

## WESLEY MEMORIAL HOSPITAL

## Monday

T. P. O'CONNOR—2 Ear, nose and throat clinic operations.

## Tuesday

GORDON WILSON—9 Otolological surgery.

## WASHINGTON BOULEVARD HOSPITAL

## Tuesday

LINN F. McBRIDE—2 Nose and throat clinic.

## Wednesday

CASSIUS and VIRGIL WESCOTT—2 Eye clinic.

## Thursday

LINN F. McBRIDE—2 Nose and throat clinic.

## CHICAGO MEMORIAL HOSPITAL

## Monday

RICHARD H. STREET—4 Tonsillectomies under local and general anesthesia.

## Tuesday

ALFRED E. LEWY and RICHARD W. WATKINS—3 Mastoids. IRVING I. MUSKAT—4 Plastic surgery.

## ALBERT MERRITT BILLINGS HOSPITAL

## Monday

D. KATZ—2 Eye clinic.

## Thursday

LOUIS BOTTMAN—9 Eye clinic.

## PRESBYTERIAN HOSPITAL

## Monday

DANIEL HAYDEN—2 Ear, nose and throat clinic.

## Tuesday

GEORGE E. SHAMBAUGH and associates—2 Otolaryngological clinic.

WILLIAM H. WILDER and associates—2 Ophthalmological clinic.

EDWIN MCGINNIS—2 Ear, nose and throat clinic.

## Wednesday

GEORGE E. SHAMBAUGH and associates—2 Otolaryngological clinic.

WILLIAM H. WILDER and associates—2 Ophthalmological clinic.

## Thursday

GEORGE E. SHAMBAUGH and associates—2 Otolaryngological clinic.

WILLIAM H. WILDER and associates—2 Ophthalmological clinic.

EDWIN MCGINNIS—2 Ear, nose and throat clinic.

## WOMEN AND CHILDREN'S HOSPITAL

## Tuesday

GERTRUDE THOMPSON—9 Tonsillectomies, Beck method.

## Wednesday

LILLIAN TAYLOR—9 Tonsillectomies, Sluder method.

GEORGIANA D. THEOBALD—9 Cataract operation.

BEULAH CUSHMANN—9 Operation on eye.

## Thursday

ALICE K. HALL—9 Tonsillectomies under local anesthesia, dissection method.

## NORTH CHICAGO HOSPITAL

(At Grant Hospital)

## Tuesday

HARRY L. POLLOCK—9 Surgical treatment of acute mastoiditis.

## Thursday

HARRY L. POLLOCK—9 Intranasal surgery.

## WEST SIDE HOSPITAL

## Wednesday

W. L. NOBLE—9 Surgery of the eye.

## Thursday

J. A. CLARK and A. E. LUND—9 Tonsillectomies.

## ST. LUKE'S HOSPITAL

## Tuesday

JOHN A. CAVANAUGH and EDWARD P. NORCROSS—2 Nose and throat clinics.

## Friday

JOHN A. CAVANAUGH and EDWARD P. NORCROSS—2 Nose and throat clinics.

## GRANT HOSPITAL

## Tuesday

O. KRAFT—9 Eye clinic.

## EYE, EAR, NOSE, AND THROAT HOSPITAL

## Monday

- A R HOLLENDER—2 Physical therapy clinic practical demonstration of the application of electrotherapy to the eye ear nose and throat  
 T S KAMMERLING—2 Eye clinic  
 H B FULLER—2 Ear nose and throat clinic  
 IGNAZ SOMMER—4 30 Intracranial relation to ear nose and throat

## Tuesday

- H B FULLER and D C BROWN—9 Ear nose and throat surgical clinic  
 O B NUGENT—11 Surgical treatment of chronic dacryocystitis  
 W A FISHER—2 Simplified Barraquer operation for cataract extraction  
 R CASTROVIEJO—4 Demonstration of various methods of ophthalmoscopy (simplified Gullstrand giant Gullstrand red free light direct and indirect)

## Wednesday

- T S KAMMERLING and L SAVITT—9 Ear, nose and throat surgical clinic  
 JOSEPH BECA—9 Surgical treatment of carcinoma of the larynx  
 O B NUGENT—11 Photography as applied to the practice of ophthalmology Demonstration of making of photographic records in ocular diseases in plastic surgery Anterior stereopticon camera fundus photography making of lantern slides photomicroscopy Motion pictures  
 T S KAMMERLING—2 Eye clinic  
 H B FULLER—2 Ear nose and throat clinic  
 IGNAZ SOMMER—4 30 Tuning fork

## Thursday

- O B NUGENT—9 Cataract clinic Cataract extraction by simplified Barraquer method teaching of cataract extraction by motion pictures  
 R CASTROVIEJO—11 Practical demonstration of slit lamp microscopy  
 H B FULLER—2 Eye clinic  
 T S KAMMERLING—2 Ear nose and throat clinic  
 IGNAZ SOMMER, R CASTROVIEJO and E CALLARDO—2 Demonstration of various laboratory methods and the practical application of clinical findings  
 R CASTROVIEJO—4 30 Histopathology

## Friday

- H B FULLER, T S KAMMERLING and O M STEFFENSON—9 Ear nose and throat surgical clinic  
 JOSEPH BECA—9 Pathology of the ear nose and throat  
 H W WOODRUFF—11 Deep incision for glaucoma, tucking operation for strabismus  
 T S KAMMERLING—2 Eye clinic  
 H B FULLER—2 Ear nose and throat clinic  
 IGNAZ SOMMER—4 30 The rôle of the nasal accessory sinuses in nasal diseases

## JOHN B MURPHY HOSPITAL

## Monday

- G W MAHONEY Emergency surgery of the eye in dustal injuries

## Tuesday

- EDWARD GARRAGHAN Operations for acute glaucoma

## Wednesday

- S SCIARRETTA Indications for operative treatment in acute mastoiditis

## ILLINOIS EYE AND EAR INFIRMARY

## Monday

- MAYOR H LEBENSOHN and EDWARD H GARRAGHAN—2 Plastic surgery of eyelids  
 U J GRIM—2 Mastoid

## Tuesday

- HERBERT S WALKER—2 Ocular muscles  
 MICHAEL GOLDENBURG—2 Some late phases of glaucoma  
 OSCAR CLEFF—2 Mastoid  
 CHARLES F YERGER—2 Radical nasal sinus operations

## Wednesday

- DWIGHT C ORCUTT and ROBERT H BECK—2 Ocular muscles and operative trachoma  
 HENRY BOETTCHER—2 Tonsils and mastoid

## Thursday

- EPHRAIM K FINDLEY—2 Cataract operations  
 EDWARD N SCHOOLMAN—2 Bronchoscopy and plastic surgery

## Friday

- E R CROSSLEY—2 Cataract operations  
 ALFRED LEWY—2 Nasal sinuses and mastoid

## POST GRADUATE HOSPITAL

## Monday

- J HAYDEN—2 Accessory sinuses

## Tuesday

- S SHER—11 Design growth of vocal cord  
 B CLISHMAN—2 Trephine for glaucoma  
 W M WOLIN—3 Septum and tonsils

## Wednesday

- E STEWART—9 Glaucoma

## Friday

- S WIENER—9 Nasal polyps and accessory sinuses

## MOUNT SINAI HOSPITAL

## Wednesday

- NOAH SCHOOLMAN, JACOB LIFSCHUTZ and associates—3 Bronchoscopy and lipiodol injections in pulmonary conditions, cesophagoscopy  
 NOAH SCHOOLMAN, JACOB LIFSCHUTZ and associates—2 Lipiodol studies and operations on accessory sinuses  
 X ray studies and operations for ear conditions

## LAKE VIEW HOSPITAL

## Monday

- FRANK J NOVAK JR—2 Suspension laryngoscopy

## Wednesday

- ROBERT H BECK—9 Demonstration of various eye operations

## ILLINOIS MASONIC HOSPITAL

## Friday

- T J WILLIAM—9 Otolaryngological clinic  
 W S BOYNTON—10 Scientific exactness in the differential diagnosis and operative treatment of strabismus

## MUNICIPAL TUBERCULOSIS SANITARIUM

## Thursday

- FRANCIS LEDERER—2 Tuberculosis of the larynx and bronchoscopy demonstrations

# SURGERY, GYNECOLOGY AND OBSTETRICS

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## THE ASSOCIATION OF ENDOMETRIOSIS WITH NEOPLASMS OF THE OVARY

E S J KING M D (Melb) F R C S (Eng) MELBOURNE AUSTRALIA

Stewart Lecturer in Pathology University of Melbourne

VERY little is known of the pathogenesis of endometriosis despite the many investigations into its nature and origin. Several hypotheses have been put forward but none of these is completely satisfactory.

Recently, the association of the condition with neoplasms of the ovary has been observed. This has suggested the idea that the endometrial abnormality may be the result of a hormone, abnormal either in amount or quality arising in the ovary.

Particularly since some of the tumors appear to arise from the epithelial—and active—elements of the organ, the follicle and luteal bodies, this association is interesting. The following cases are considered worthy of record since various types of endometrial proliferation are here found associated with ovarian tumors. It is proposed to show that the ovarian tumors possibly bear a close causative relationship to the abnormal endometrium.

**CASE 1.** Miss F W, aged 51 years. The patient complained of intermenstrual bleeding which commenced suddenly 16 months previously. She had been operated on 32 years before for a growth in the spinal region. For the last 9 years she had had ascites which has been tapped at intervals. She had also had attacks of angina pectoris. Menses had not ceased when the bleeding commenced. This was very severe. She had been in bed for 10 months because of weakness.

Her general condition was very poor, extreme anaemia being present. A very irregular knobby mass was felt in the suprapubic region arising from the pelvis and reaching halfway to the umbilicus. Marked enlargement of the uterus (myomata) was observed. Radium was inserted into the uterus to control the haemorrhage. The patient improved sufficiently for an operation to be performed. Panhysterectomy was performed 1 month later.

**Pathological examination.** The specimen consists of the uterus, fallopian tubes and both ovaries. The uterus was two to three times larger than normal—measuring 7 inches by  $3\frac{1}{2}$  inches by  $3\frac{1}{2}$  inches (taking the average measurements) of hard consistency and irregularly lobulated (Fig 1). The fallopian tubes showed several small lobulations at various positions along their lengths. The right ovary was slightly enlarged— $1\frac{3}{4}$  inch by  $\frac{3}{4}$  inch by  $\frac{3}{4}$  inch, being irregular in shape, the irregularities were due to multiple cysts. The left ovary was smooth solid, and measured  $1\frac{1}{2}$  inches by 1 inch by  $\frac{3}{4}$  inch.

**Macroscopic examination.** The uterus showed (Fig 2) multiple myomata and on the cut surface of these could be seen small slits and spaces. These tumors showed the whorling (Fig 3) which is so characteristic of the adenomyomata and which differs from that of the ordinary myomata in being of a much finer type. Posterior to the cavity of the uterus there was a large glandular space forming a small uterine cavity, a space lined by epithelium and having no connection with the uterine cavity proper. The cervix showed marked cystic dilation of the glands, and some sections revealed a number of small spaces similar to those visible in the uterus. The right ovary showed multiple small cysts of varying size and shape, some of which contained blood. The left ovary showed the organ to be replaced almost completely by tumor (Fig 4) only.



## EVANGELICAL DEACONESS HOSPITAL

*Monday*

ARTHUR GEIGER—2 Deflection of the nasal septum

*Tuesday*

G THOMPSON von COLDITZ—2 Types of tonsil operations

## COLUMBUS HOSPITAL

*Tuesday*

C O LINDSTROM—9 Mastoiditis and various types of tonsillectomies

*Wednesday*

L R. MELLER—9 Plastics on nose

## RAVENSWOOD HOSPITAL

*Friday*

A N MURRAY and W J NOOVAN—2 Otolaryngological clinic.

## FRANCES E WILLARD HOSPITAL

*Monday*

W D BRODE and C T CARR. Nose and throat clinic

*Tuesday*

FRANK J NOVAK Acute mastoiditis

## GARFIELD PARK HOSPITAL

*Tuesday*

L B PHELPS—9 Indications for operative treatment in acute mastoiditis

## CHILDREN'S MEMORIAL HOSPITAL

*Tuesday*

MORRIS COTTE—9 Surgical and non-surgical ear diseases in infancy

# SURGERY, GYNECOLOGY AND OBSTETRICS

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## THE ASSOCIATION OF ENDOMETRIOSIS WITH NEOPLASMS OF THE OVARY

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VERY little is known of the pathogenesis of endometriosis, despite the many investigations into its nature and origin. Several hypotheses have been put forward but none of these is completely satisfactory.

Recently the association of the condition with neoplasms of the ovary has been observed. This has suggested the idea that the endometrial abnormality may be the result of a hormone abnormal either in amount or quality arising in the ovary.

Particularly since some of the tumors appear to arise from the epithelial—and active—elements of the organ, the follicle and luteal bodies, this association is interesting. The following cases are considered worthy of record since various types of endometrial proliferation are here found associated with ovarian tumors. It is proposed to show that the ovarian tumors possibly bear a close causative relationship to the abnormal endometrium.

**CASE 1.** Miss F. W. aged 51 years. The patient complained of intermenstrual bleeding which commenced suddenly 16 months previously. She had been operated on 32 years before for a growth in the spinal region. For the last 9 years she had had ascites which has been tapped at intervals. She had also had attacks of angina pectoris. Menses had not ceased when the bleeding commenced. This was very severe. She had been in bed for 10 months because of weakness.

Her general condition was very poor, extreme anæmia being present. A very irregular knobby mass was felt in the suprapubic region arising from the pelvis and reaching halfway to the umbilicus. Marked enlargement of the uterus (myomata) was observed. Radium was inserted into the uterus to control the hæmorrhage. The patient improved sufficiently for an operation to be performed. Pan-hysterectomy was performed 1 month later.

**Pathological examination.** The specimen consists of the uterus, fallopian tubes and both ovaries. The uterus was two to three times larger than normal—measuring 7 inches by  $3\frac{1}{2}$  inches by  $3\frac{1}{2}$  inches (taking the average measurements) of hard consistency and irregularly lobulated (Fig. 1). The fallopian tubes showed several small lobulations at various positions along their lengths. The right ovary was slightly enlarged— $1\frac{1}{4}$  inch by  $\frac{3}{4}$  inch by  $\frac{3}{4}$  inch, being irregular in shape, the irregularities were due to multiple cysts. The left ovary was smooth solid and measured  $1\frac{1}{2}$  inches by 1 inch by  $\frac{3}{4}$  inch.

**Macroscopic examination.** The uterus showed (Fig. 2) multiple myomata and on the cut surface of these could be seen small slits and spaces. These tumors showed the whorling (Fig. 3) which is so characteristic of the adenomyomata and which differs from that of the ordinary myomata in being of a much finer type. Posterior to the cavity of the uterus there was a large glandular space forming a 'small uterine cavity' a space lined by epithelium and having no connection with the uterine cavity proper. The cervix showed marked cystic dilation of the glands and some sections revealed a number of small spaces similar to those visible in the uterus. The right ovary showed multiple small cysts of varying size and shape, some of which contained blood. The left ovary showed the organ to be replaced almost completely, by tumor (Fig. 4) only.

a thin rind remaining. The growth was soft and had radiating clefts in it.

**Microscopic examination.** The spaces in the uterus were typical endometrial gland like spaces with the surrounding characteristic stroma (Fig 5). While most of these tumors were thus, adenomyomata, one or two showed no evidence of aberrant epithelium. Near the central part of the uterus the epithelium was degenerated and the connective tissue had undergone hyaline change. This was considered to be the effect of the previously inserted radium. The larger spaces and cysts in the region of the cervix showed epithelium of the cervical type, but most of the smaller spaces were typically endometrial in character. Section of the nodules in the fallopian tube showed small areas of endometrial tissue at some distance from the cavity of the tube, and two of them were followed by serial section to demonstrate their independence of the mucous membrane of the fallopian tube. The cysts in the right ovary were mainly lined with a single layer of cells but some were obviously developed from graafian follicles. One or two showed proliferative activity of the cells. This activity of graafian follicles in similar cases has been previously remarked elsewhere (12).

The tumor in the left ovary presented curious characters which differed in various parts. It showed collections of cells resembling the structure of a graafian follicle (Fig 6) massive papillary development into large cystic spaces (Fig 10) solid carcinoma with blood spaces lined by cuboidal cells (Fig 7) typical spheroidal carcinoma in one small area (Fig 8), and in some portions the growth showed a considerable amount of hyaline material which closely resembled that of a corpus albicans (Fig 9).

**CASE 2.** Mrs B H widow, aged 62 years. The family history revealed nothing of note. She had had an operation for fibroids 18 years previously. There had been a suppression of menses at this time, but these had recurred for a period of 12 months after the operation.

Three weeks before admission she had noticed a swelling in the lower abdomen associated with a slight hæmorrhage *per vaginam*. Six days later, she had a severe hæmorrhage. This lasted 3 days and there was an offensive odor. She had lost no weight and felt well. The abdomen showed the scar of the previous operation. There was a soft mass in the hypogastrium a little more on the right side. A large tumor was palpable felt bimanually, in the right and posterior fornices.

At operation it was found that a large cyst replaced the right ovary. The cyst was somewhat adherent to the uterus, the anterior abdominal wall and the pelvic wall. Removal was performed with difficulty.

**Pathological examination.** The uterus was macroscopically, apparently normal. The large cyst which replaced the ovary on the right side was about 4 inches in diameter and contained dark

fluid blood and old clots. One side of the cyst wall was thickened.

**Microscopic examination.** The uterine mucosa showed marked hyperplasia though there was no undue invasion of the muscle coat. Section of the thickened portion of the wall of the ovarian cyst showed carcinomatous tissue of the same type as in Case 1 (Fig 12). The cells were small with relatively large, deeply staining nuclei. They were arranged in large masses. In some places the groups of cells were embedded in hyaline tissue. Cells of the same kind also lined the cavity of the cyst (Fig 11).

The tumors in both of these cases for reasons to be given subsequently, were considered to be granulosa cell tumors. A further case is of interest since the aberrant endometrium is associated with an ovarian tumor growing in a luteal cyst.

**CASE 3.** Mrs F L, aged 45 years. She complained of pain in the lower abdomen for the previous month. She had had two children both alive and well. The younger was aged 15. She had not felt well for the previous 4 months. At her last menstrual period 1 month ago she had lost more than usual. During this period and for the recent month she had had a bearing down pain in the lower abdomen which was worse on the right side than on the left. There had been pain across the back in the sacral region for a long time. She had also had an intermenstrual discharge for years. She was constipated particularly during the periods. Micturition was normal. She thought that she had been losing weight.

There was a mass in the hypogastric region movable, tender and reaching to the umbilicus. A smaller mass was palpable in the right iliac fossa hard tender, and causing pain down the right thigh. The masses were felt here and diagnosed as uterine myomata and cyst of the right ovary respectively. There was a thickening behind the cervix extending into the rectovaginal septum. This was provisionally diagnosed as adenomyoma of the rectovaginal septum. A panhysterectomy (block dissection) was performed.

**Pathological examination.** The large irregular uterus contained multiple myomata. Behind the cervix there was a small piece of tissue resembling a myoma but containing spaces. The cyst of the ovary  $3\frac{1}{2}$  inches in diameter, contained old blood (chocolate material) and had papillary masses growing into its cavity.

**Microscopic examination.** The postcervical mass showed typical endometrial glands throughout the tissue (Fig 4). The myomata were unfortunately destroyed before microscopic examination was made. The chocolate cyst showed atypical luteal tissue in its wall. The papillae were typical of those seen in a papilliferous cyst of the ovary (Fig 15).

All of these cases have in common the presence of an obvious ovarian abnormality—a neoplasm. Also, the association of an ovarian tumor with uterine bleeding is noteworthy. This immediately directs attention to the condition of the endometrium, which was, in all these cases, pathological, showing either local hyperplasia or proliferation in abnormal situations. In Case 2 there is merely a hyperplasia of the endometrium in its normal situation, which is striking, however, in consideration of the age of the patient. In Case 1 there was an extensive involvement of the uterus and to a less extent the fallopian tubes with aberrant endometrial glands. Case 3 presents endometrial glands in the rectovaginal septum.

It has been suggested by Meyer and Neumann that the stimulus responsible for aberrant endometrial growth may be found in the diseased ovary. Several cases have been reported showing a relationship between ovarian growths and hyperplastic or heterotopic endometrium. Schroeder reported a granulosa celled tumor associated with granular hyperplasia which in some degree suggested carcinoma, and Tietze showed the relationship of a similar growth to both hyperplastic and to aberrant growth of endometrium.

The exact pathological status of endometriosis—whether it be a true blastoma, an inflammatory condition due to a migration of tissue from the normal endometrium, or other cause, is still undecided. None of these hypotheses is satisfactory but from several points of view, the suggestion that one of the exciting factors is hormonal, from the abnormal ovary is very attractive. Even if we could show that the disease of the ovary was in a casual manner related to these conditions of endometriosis there must still be some other factor or factors which determine the exact site and nature of the growth.

A study of the physiological relationships of the functional portion of the ovary (particularly the corpus luteum) with the endometrium has demonstrated an extremely close association both in menstruation and pregnancy. The changes in the endometrial stroma are particularly interesting. At these times the stroma cells swell and form characteristic decidual cells. It has been shown recently,

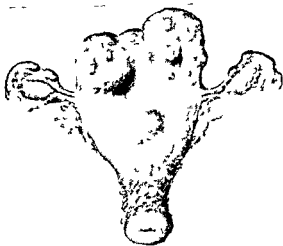


Fig 1. Case 1. The specimen of uterus, fallopian tubes and ovaries as removed at operation. The uterus is irregularly enlarged showing multiple adenomyomata (Compare with Fig 11). The nodules in the fallopian tubes showed on section aberrant endometrial tissue. The right ovary contains many small cysts while the left is uniformly enlarged. (See Fig 4.)

that these cells occur not only in the endometrium, but among other places in the peritoneum, fallopian tubes, and bowel. This occurs in menstruation as well as pregnancy. It is unknown why certain cells and not others should be affected by what seems undoubtedly to be a hormone arising in the ovary, the reason for and the nature of this discrimination is at present a complete mystery.

The distribution of these aberrant decidual cells is very similar throughout the body to that of endometriosis. The relationship, if any, that these decidual cells bear to heterotopic endometrium is unknown, but the similarity of distribution suggests that there is some connection. Since the decidual cells are closely associated with ovarian activity, the presence of some ovarian abnormality in cases of endometriosis is very suggestive of a common causative factor between the two.

In the type of case under discussion, there is an obvious pathological lesion—a neoplasm. Later it is possible that other diseases of the ovary may be shown to produce similar endometrial change.

The consideration of the type of ovarian neoplasm with which these endometrial conditions are associated is important.



Fig 2 Case 1 A median sagittal section of the uterus. Multiple tumors are present containing many small gland-like spaces in the muscle tissue. The uterine cavity is cut only in part owing to deformation due to the presence of the tumors. The space posterior to this is a small uterine cavity not having any connection with the central cavity of the uterus. Cystic dilatation of the glands in the cervical region is present.

In two cases (Cases 1 and 2) there was a typical granulosa cell tumor. The reasons for so describing these tumors are that the cells resembled in the shape and the staining qualities of their nuclei, the cells of the granulosa layer of the graafian follicle (Fig 7), in a considerable part of the tumor they were arranged in small groups resembling the adult follicle (Fig 6), in other parts the massive arrangement of the cells was like that of the follicle. Small spaces resembling the Call and Turner bodies were frequent throughout the tumor. (See Fig 12) the formation of spaces resembling the theca folliculi were frequent (Fig 11). The presence of blood vessels throughout the tissue was unlike the true stratum granulosum, but this occurrence of



Fig 4 Case 1 Section of both ovaries. The right shows numerous small cysts, the left shows the tumor which has replaced the ovarian tissue almost entirely.



Fig 3 Case 1 Photograph of a sagittal section of the uterus parallel to that shown in Figure 2. The fine whorling which is characteristic of adenomyoma is seen.

vessels among epithelial cells is common in epithelial neoplasms. Tumors of this nature have been described on several occasions (11, 13, 15, 17, 18, 20, 22, 23, 27).

A considerable amount of hyaline tissue was present among the groups of cells, constantly reminding one of corpora albicantia. It is possible that cells so closely related to the luteal cells—being allied to their progenitors—may cause a change in the connective tissue similar to that produced in the aging corpus luteum.

In describing these neoplasms as granulosa cell tumors it is not meant to infer necessarily that they arise from the cells of a graafian follicle but rather that they possibly come from cells in the ovary which are the progenitors of these follicular cells. As has been stated the neoplastic elements themselves resemble the cells of the graafian follicle and since this is so the cells may possibly function in a manner similar to those of the corpus luteum. This opens up a most interesting avenue of research.



Fig 5

Fig 6

Fig 7



Fig 8

Fig 9



Fig 10



Fig 11

Fig 12



Fig 13

Fig 5 Case 1 Section of portion of one of the tumors of the uterus showing typical glandular structure  $\times 110$

Fig 6 Case 1 An alveolar area characteristic of a considerable portion of the tumor The space very closely resembles a graafian follicle  $\times 130$

Fig 7 Case 1 A portion of the solid part of the tumor showing a blood space lined by cuboidal cells  $\times 160$

Fig 8 Case 1 A small portion of the tumor showed typical spheroidal carcinoma  $\times 400$

Fig 9 Case 1 A portion of the tumor showing a loose alveolar structure The hyaline supporting tissue occurred throughout a large part of the tumor  $\times 250$

Fig 10 Case 1 A projection of a solid mass into the central space of the tumor  $\times 65$

Fig 11 Case 1 Formation of spaces among the cells This occurred throughout a large part of the tumor  $\times 150$

Fig 12 Case 2 Portion of the wall of the cyst in the ovary showing the cells lining it These cells resemble those of a graafian follicle and small spaces are present resembling the Call and Exner bodies  $\times 180$

Fig 13 Case 2 The typical appearance of the tumor at the thickened part of the cyst wall The cells are of the granulosa type hyaline nature of the connective tissue is seen in the lower portion of the section  $\times 110$



Fig. 14 (left) Case 3 The section shows the glandular structure in the muscle of the tissue of the rectovaginal septum  $\times 110$

Fig. 15 Case 3 A section of the papillary growths into the chocolate cyst  $\times 200$

A considerable number of facts are already in our possession. The contents of follicular cysts have been shown in animals to contain material which may largely replace the internal secretion of the ovaries (1, 2, 3, 4, 8). The degree of the effect of the hormone on the endometrium and upon the epithelium of the vagina is considerable. These and similar observations have been made by several observers (5, 6, 7).

In the lower animals the amount of secretion waxes and wanes with the activity of the follicles but in the primates the amount of internal secretion is maintained by the cells of the developing corpus luteum (1, 9). It has been suggested that this is the explanation of the difference between the menstrual cycle of the higher animals as compared with the estrus cycle of the lower mammals.

However this may be, there is a hormone arising in the follicle which is closely related to the internal secretion of the corpus luteum (10).

Both these secretions have a specific stimulating effect on the endometrium. It is therefore, probable that tumors consisting of cells which are closely allied to the granulosa cells—and therefore are presumably capable of producing the follicular hormone—which may be abnormal either in amount or quality—

may have a considerable effect on the endometrium. This effect in these cases, is apparently to cause overgrowth.

There is also another factor. It has been shown that embryonic tissue possesses some of the hormone and thus the tumor which is essentially cells of an anaplastic type may contain additional amounts of the hormone in question.

In the other case (Case 3) there is a tumor arising in a luteal cyst. It is considered that this arises from the heterotopic epithelium which occurs in luteal cysts and Shaw has described such a case and has given this suggestion. The author has also reported a case of carcinoma arising in such a cyst and reasons for considering that the origin was from these same cells were given.

The origin of these cells has also been discussed. Shaw considers that they arise by metaplasia from endothelium; the writer considers that they possibly arise from luteal cells.

When we consider that the cells of the granulosa layer of the graafian follicle develop into the cells of the corpus luteum it is not surprising that the tumors under discussion should have similar functional associations. Further speculation in this direction is however futile until the origin of the cells lining luteal cysts is beyond doubt.

More material is also necessary before adequate and justifiable deductions can be made concerning the relation of these growths occurring in the ovary to hyperplastic and heterotopic endometrium

## SUMMARY

- 1 Three cases of ovarian tumor associated with abnormal endometrium are described
- 2 Two of the tumors are granulosa cell tumors and a third arises in a luteal cyst
- 3 The possible causative relationship is discussed

Grateful acknowledgment is due to Mr R Fowler for the specimens and the notes of the cases to Dr J Fiddes for the drawings and to Mr E Burt for serial sections made of Case 1

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## RADIUM STERILIZATION OF THE FEMALE ALBINO RAT (MUS NORVEGICUS)

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THE Gynecologic Hospital Institute of Gynecologic Research of the University of Pennsylvania is making a clinical study of the effects of pelvic irradiation in women upon the health and development of subsequent offspring.

A review of the literature dealing with the health and development of animal and human offspring has already been published in this connection (4). In addition, a report has been published, which summarizes the existing information concerning experimental ovarian irradiation (3). Other clinical studies of a related nature have just been completed (5).

Extensive animal experiments are being conducted, parallel with the clinical investigation, to determine the influence of pelvic radium and roentgen irradiation of the female albino rat upon the health and development of their subsequent progeny. In these experiments radium is employed *before* while roentgen rays are used *after* conception.

The consequences of *preconception radium irradiation* will be reported in two installments. This paper (the first installment) concerns the amount of radium exposure necessary to *sterilize* the female rat permanently. The second report will deal with the reproductive powers of the animals which were not sterilized by the irradiation and the health and development of the offspring of the fertile animals, as they may have been affected by the previous maternal irradiation.

For the purpose of this study the *sterilizing radium exposure* is defined as the amount of irradiation which will inhibit reproduction in the case of any single animal, for at least 4 months following the treatment and mating of that animal. If it is assumed that the life cycle of the rat is consummated in  $\frac{1}{30}$  of the time required for the human life cycle as stated by Donaldson (1), then 4 months of sterility in the rat is equivalent to 120 months (10 years) in the human being. Since 10 years' sterility in the case of the latter usu-

ally means permanent sterility, its equivalent of 4 months for the rat is here taken as permanent.

At the beginning of the investigation it was further decided that if sterilization of all the animals receiving a certain dosage was not accomplished, then the term "sterilizing exposure" would be used as indicating the amount of irradiation which would sterilize at least 60 per cent of them.

A standard sterilizing dose is necessary as a relative measurement for the *substituting* and *maximum substituting* doses. The experiments with these smaller doses are treated in the second installment of this report, which will be published in the near future.

One hundred and twenty-eight albino rats were subjected to radium exposure of the ovaries, the radio active substance being applied on the body surface. As is shown in the accompanying tables, exposures of various durations were given to the different groups of animals. The doses employed were sufficiently large to kill many of the animals. Of those surviving the treatment the majority had been rendered sterile while a few cast litters in spite of the irradiation. The technique of the irradiation, the amount of exposure used, and the influence of the treatments upon the reproductive function of the animals form the basis for this report. It must be pointed out, however, that the object of the experiments related here was only to determine whether the irradiated animals could subsequently reproduce or not.

We have adopted this functional standard in preference to judging the sterilizing effect of the radium from a less definite *histological* point of view, and this mainly for the two following reasons: (1) The appearance of the young ones is the best index of the power of reproduction and the surest means of its accurate determination. (2) It was necessary to maintain the entire rat colony for a considerable length of time in order to study the

influence of irradiation upon the health and development of later offspring

The series of radium treatments, outlined below, was begun in November, 1927, and carried over a period of nearly a year. The *radium exposures* were all given in the Radium Research Laboratories of the Philadelphia General Hospital, through the courtesy of the Cancer Research Committee of that institution. The rest of the experimental work was carried out in the laboratories of the Gynecean Hospital Institute.

#### MATERIAL AND METHODS

Virgin albino rats, at the optimum breeding age of 120 days (2), were used in all experiments. The animals were procured from the Wistar Institute of Anatomy and Biology just prior to the time of treatment.

The rat was selected chiefly because it could be secured from healthy parasite free stock with pedigree of many generations. The known pedigree was considered of special value for the later part of the study, i.e., the part dealing with the influence of irradiation upon the health and development of the offspring. The freedom from parasitic infestation was also important, as the anemia, frequently associated with parasitic infestation in the rat, often is the cause of sterility.

Virgin animals were selected in order that all litters born immediately after irradiation should be first litters, thus eliminating the factor of variation due to differences in the sequence of pregnancies. Furthermore according to Duhring, less than 2 per cent of the 120 day old virgin rats from the Wistar Institute Experimental Rat Colony are found to be sterile. Pre-existing sterility in these animals need not therefore, be seriously considered.

The age of 120 days was chosen since this has been demonstrated (in the Wistar Institute Colony) to be the optimum breeding age in rats.

All animals were received in a healthy condition and by careful management we succeeded in maintaining the colony without serious losses from pulmonary or intestinal infections, the two most common causes of death in the laboratory rat.

The animals were housed in metal cages with wire gauze floors, which permitted immediate escape of all excreta, especially urine. As a result, the animals were kept dry at all times and, thus, the danger of chilling was minimized and the death rate from subsequent pneumonia kept low. In addition, the room temperature was kept above 68 degrees Fahrenheit throughout the colder months of the year. The cages were cleaned daily, in order to keep the number of parasitic vermin as low as possible. Cages found to be infested were immediately sterilized in boiling water.

The animals were kept supplied with food at all times. Fresh food, both raw and cooked, was prepared daily. Green vegetables were fed at least twice a week and were the only uncooked foods in the diet, lettuce being the one most commonly given. In order to remove all parasitic ova the green vegetables were thoroughly washed and the rest of the foods were thoroughly cooked. The diet varied from day to day, usually cornmeal or hominy grits being used as its basis. To these were added tomatoes, salmon, beans, peas, fresh meat with bones and fresh fish. The colony received fresh meat or green vegetables of some kind practically every day. The care of the animals and the attention to diet were necessary to maintain the colony on a healthy condition throughout the experiment and to give optimum conditions for breeding. The varied and full diet, as briefly outlined above, was used in order to ensure a constant and full vitamin supply, a deficiency of which is known to favor sterility in the rat.

Radium was selected as the source of irradiation because of its frequent use in gynecologic practice, and also because a relatively large supply (2 grams) was available in the Laboratories of the Philadelphia General Hospital. Furthermore, this element had not been so frequently used in earlier experiments with ovarian irradiation in the lower animals.

The radium was available in the form of emanation or radon. This has the advantage over the radium salt that it can be condensed into a smaller volume, thus making it possible to bring the radiant source closer to the object to be irradiated.



Fig. 1. A pair of bakelite holders with hinged copper covers used for maintaining the radon capsule in close approximation to the rat's back. The thickness of the bakelite was made less than the width of the brass capsule (3 millimeters). The hinged cover was also made shorter than the opening in the bakelite. These two construction details made possible a close approximation of the capsule to the animal's body.

Approximately 500 millicuries of radon, in a single radon containing capsule, were employed for each series of animals treated. It was possible to use this large amount of radon in the treatment of most of the animals, thus making the necessary period of exposure comparatively short. The radon was measured by means of an electroscope both before use and after the completion of any series of treatments. This made possible an accurate estimation of the value of the radon used and was a check on the possible loss of emanation during the experiment.

A brass capsule was used to hold the radon containing glass tubes and to filter out the alpha and beta rays (Fig. 1). It was 20 millimeters long, 8 millimeters in outside diameter and 2 millimeters in thickness. The radon tubes were 14 millimeters long.

Dissections and frozen sections of the entire rat's body showed the ovaries to lie approximately 1 centimeter beneath the skin surface at a point about 1.5 centimeters lateral to the mid-pinal line and an equal distance caudal to the lowest rib. In all of the radium treatments an attempt was made to center the brass capsule over this point.

The rat was held at full length in the hands of an assistant, care being taken not to change the normal relationship between the rat's skin and the underlying structures. The lower thoracic and lower abdominal regions were then snugly enveloped in bands of zinc-oxide adhesive plaster (Fig. 2). This was done in order to limit the voluntary movements of the rat during the period of radium exposure,

which in most cases lasted the best part of an hour, and also to facilitate the application of the pair of bakelite holders (Figs. 1 and 2) used to maintain the accurate approximation of the radium capsule to the rat's back. When the bakelite holders were firmly in place the brass capsule containing the radon was placed in the holder on the right side of the rat's body and the hinged cover was brought into position over the capsule to hold the latter firmly against the underlying skin and hair. The animal was then placed in a wire basket for the desired time of exposure. At the end of this time the radon containing capsule was removed and placed in the holder on the left side for an equal period, after which the rat was removed to her cage. Each rat, therefore, received two exposures, the first one over the right, and the second over the left ovarian region, immediately following the first.

Four of the animals reported upon in the present study were mated 6 days after irradiation but the remaining 124 rats were not mated until 14 days after treatment. The 14 day interval was finally decided upon for several reasons. First of all, we wished to make sure that should young ones be born in spite of the irradiation, they would result from fertilization of ova present in the ovary at the time of the treatment and not of ova which might have been in the oviducts at that time. Since it has been observed by others that the ova may live in the oviducts for 3 or 4 days it was believed that at least 7 days should be allowed to pass before mating. Secondly, it was observed that the first local response of the rat's skin to the irradiation did not manifest itself until about the fourteenth day following irradiation. At this time alopecia developed in the treated area in most instances. It was presumed on no other grounds than the above, that the ovaries might also show the first and perhaps most active response to the irradiation on or about the fourteenth day. It was therefore believed that ova fertilized at or about this time would more likely have been damaged by the irradiation than would ova fertilized at an earlier date. Another reason for allowing a lapse of 14 days between treatment and mating was the fact that most

women, giving birth to children after preception pelvic irradiation, do not become pregnant at once (4). A 14 day interval in the case of the rat would correspond approximately with a 14 month interval in the case of a woman.

Table I shows the number of animals which received preception ovarian irradiation, arranged according to amount of exposure. The first attempts to bring about sterility were made with the smallest exposures. When these failed the doses were increased until definite sterilizing effects were secured. The large number of animals receiving 450 millicurie hours of exposure over each ovary were so treated in order to secure a large number of subsequent offspring for a study of the influence of the maternal irradiation upon them.

Table II shows that of 128 irradiated animals 10 died before mating. These deaths were apparently all due to the irradiation rather than to other causes, a severe diarrhoea preceding death in all cases. No fatality occurred after the smaller doses of radium exposure. The larger the dosage the higher was the death rate. It will be observed that only 100 out of 128 irradiated rats were actually mated.

Table III shows that 15 animals died within 4 months after mating. Thus, only 94 of the 128 irradiated animals lived for 4 months or more following mating. Furthermore it will be observed that these deaths followed the larger amounts of radium exposure. It is assumed therefore that they were the direct result of the irradiation, since marked losses of weight and diarrhoea were observed in many instances. These were more frequent and severe after the larger exposures. Of the 15 animals just mentioned, 3 were found to be pregnant at death, while the remaining 12 were sterile.

The sterility frequency of all mated animals, irrespective of how long they lived after mating was found to be as follows. Of 109 mated animals 51 (approximately 47 per cent) were observed to be sterile at death or were sterile for 4 months after mating, while 58 (53 per cent) were observed to be fertile. These figures include the 15 animals which died within 4 months of mating time. Table IV



Fig. Radium holders strapped to back of rat in position for ovarian irradiation. Note capsule present in the right holder.

shows that of the 94 animals which lived for 4 months, 39 were sterile at the end of that period, constituting a sterility percentage of approximately 41. This approximates that of the entire group (47 per cent) of the irradiated and mated animals. It would seem, therefore, in a consideration of the sterility frequency of the mated animals, that the animals which died before the end of the 4 month period might well be included in the grand total.

It will be observed in Table IV that radium exposures of less than 450 millicurie hours had no appreciable influence upon fertility with the one exception, nor did they have any appreciable effect upon the death rate after mating (Table III).

Among 28 animals which received less than 450 millicurie hours of treatment (Table II) no death occurred before mating and only one after mating (Table III). Of the remaining 27 animals only 4 were sterile, representing a sterility frequency of only about 14 per cent.

In 81 animals which received 450 millicurie hours of irradiation or more (Table II) 19 deaths occurred before mating and 15 after mating (Table III). The remaining 47 cast only 12 litters which gave a sterility percentage of approximately 74.

Thus exposures of 400 millicurie hours and less gave a 14 per cent sterility against a sterility of 74 per cent where 450 millicurie hours or more were employed, excluding all deaths.

This study has brought out the fact that there is a wide difference between the amount of ovarian radium exposure necessary to sterilize a woman and the amount which will sterilize the rat. An accurate estimate of this

TABLE I—THE NUMBER OF ANIMALS TREATED WITH THE VARIOUS AMOUNTS OF IRRADIATION

Animals	Mc hrs
1	200
2	300
10	350
15	400
50	450
16	500
3	550
13	600
18	650
128	

The amounts of exposure expressed in millicurie hours after the sizes of the treatments that we directed at each ovary separately. Each animal therefore received twice the exposure given to one ovary. The largest group was given 450 millicurie hours of irradiation in order to secure a large number of offspring for the subsequent part of the experiment.

difference is difficult, largely because of variations in techniques employed.

Human treatment is usually given by means of a single application in the uterine cavity, at a point mid way between the ovaries. In the case of the rat it was found best to irradiate each ovary separately through the body wall.

Although women vary considerably, one from the other, in their response to ovarian irradiation, for the purpose of this study it is assumed that 1,000 millicurie hours of intra-uterine treatment will sterilize most women so exposed. It is further assumed for purposes of estimating dosage that the human ovaries usually lie approximately  $2\frac{1}{2}$  inches (6.25 centimeters) from the center of the uterine cavity.

According to the "law of inverse square" if the rat ovary lies only 1 centimeter beneath the skin surface as has been previously stated, no more than 27 millicurie hours of exposure would be necessary to produce sterility. As a matter of fact the sterilization dose for one rat ovary was found to be in the neighborhood of 650 millicurie hours of exposure. This is approximately 24 times the amount of treatment necessary to sterilize a human being. If the total amount of millicurie hour dosage only is considered omitting from consideration the other factors such as the distance of the radium from the ovaries the number of exposures, etc., it will be seen that 1,300 millicurie hours of treatment were required

TABLE II—THE NUMBER OF IRRADIATED ANIMALS WHICH DIED BEFORE THEY COULD BE MATED, ARRANGED ACCORDING TO THE AMOUNT OF IRRADIATION

A m ls	Mc hrs	Treated	Dead
1	200	1	
2	300	2	
10	350	10	
15	400	15	
47	450	50	3
14	500	16	2
2	550	3	1
4	600	13	9
13	650	18	4
109		128	19

Note that no deaths occurred until at least 450 millicurie hours of exposure had been given and that the death rate was extremely high (66 per cent) when 600 millicurie hours were employed.

to sterilize the rat, as compared to 1,000 millicurie hours for women. The rat therefore actually required more exposure than the human though many times smaller than the latter.

It is shown in Table IV that not one of the 13 animals (Table I) which received 600 millicurie hours of treatment cast a litter. However, only 2 of them survived the irradiation, while 5 first litters were observed among the 13 animals which lived 4 months and received the still large dose of 650 millicurie hours.

If we consider as one group the two series of animals subjected to these high exposures (600 millicurie hours and 650 millicurie hours) we observe the following. Of 31 animals 13 died before mating and 3 after mating. Fifteen animals survived. Of these 10 (66 per cent) were sterile. Thus because two thirds of the surviving animals were subsequently sterile the sterilizing exposure for the rat as employed in this series of experiments is taken to be in the neighborhood of 650 millicurie hours.

#### DISCUSSION

From the foregoing we conclude that absolute sterilization of all rats could not be accomplished by even the largest amounts of irradiation. It would seem that this was dependent upon a number of factors most of which were no doubt beyond control. First the periovarian fat may have varied in amount from animal to animal thus causing a variation in the distance between ovary and radium. Second the position of the radium

TABLE III—THE NUMBER OF IRRADIATED ANIMALS WHICH WERE MATED AND THE NUMBER OF THESE WHICH DIED WITHIN 4 MONTHS OF MATING

An mals mated	Mc hrs	Dead
1	00	
2	300	
10	350	1
15	400	
47	450	5
14	500	5
2	550	1
4	600	2
14	650	1
100		15

Of the dead an mal 1 was found to be sterile and 3 were pregnant at death—2 of the latter had 500 millicurie each and the third 650 millicurie hours on each ovary. Note that these animals were not pregnant until 450 millicurie hours of irradiation had been administered.

applicator in relation to the ovary may have been altered by inaccurate application of the bakelite holder (Fig. 2) to the dorsum of the rat. This is unlikely, however, as every effort was made to prevent any variation in this respect. Thirdly in changing position in the basket during treatment the rat may have altered the relative position of the radium.

In addition to variations due to these mechanical influences, the reproductive powers of the animals may have varied due to conditions less easily explained.

The systemic or the local effects of the radium treatments may have had some influence upon fertility. Following the shorter exposures no appreciable systemic effects were observed while the larger amounts of irradiation would cause evident loss of weight. Weekly weighings of a number of animals, receiving 450 millicurie hours or more, showed the weight loss to amount to as much as one-fourth of the pre-treatment weight. This decline was as a rule observed within one week of the time of treatment, usually reaching its maximum by the end of the fourth week. In most instances the weight would gradually return to normal in the course of 6 or more weeks. This considerable loss of weight in certain cases, was associated with diarrhoea.

It is reasonable to suppose this systemic effect of the irradiation may have played a rôle in altering the fertility of the animals although the promptness with which many of them became pregnant after irradiation would indicate the contrary.

TABLE IV—THE FREQUENCY OF STERILITY IN IRRADIATED ANIMALS WHICH LIVED 4 OR MORE MONTHS AFTER MATING, ARRANGED ACCORDING TO THE AMOUNT OF IRRADIATION

Anim Is mated	Mc hrs	Sterile	Per cent
1	200		
2	300	1	50
9	350	1	11
15	400	1	13
42	450	22	52
9	500	3	33
1	550		
2	600		100
13	650	8	61
94		39	

With the exception of the 2 an mals which received 300 millicurie hours of treatment over each ovary, there was no marked increase in sterility until 450 millicurie hours of irradiation were reached.

According to the amount of exposure, the local response of the rat's body to the irradiation varied from simple depilation to the production of extremely large and deep ulcers. In most cases these ulcers healed but as a rule, only after many weeks' duration. Several of the ulcers penetrated the entire thickness of the body wall, but in only one instance at autopsy was the burn found to involve the underlying tube and ovary. The burns were severe enough to produce paralysis of the hind extremities in four cases. In two of these microscopic section indicated that the underlying spinal cord had been completely destroyed.

The question arises as to whether the effect of the radium upon the reproductive function was due solely to its direct action on the ovaries or partly to its indirect systemic influence as well. It has also been suggested that perhaps, the local ulceration of the body wall in many cases may have interfered with the act of copulation. The promptness, however, with which conception was observed to take place even after the larger amounts of irradiation leads us to believe that the systemic and other influences did not play any rôle in producing sterility.

#### SUMMARY

1. One hundred and twenty-eight virgin adult albino rats received irradiation for the purpose of influencing ovarian function.

2 One hundred and nine of these irradiated animals lived to be mated on the fourteenth day following treatment, 19 animals dying before that day from the effects of irradiation

3 Fifteen of the remaining animals died within 4 months of treatment and mating as result of the irradiation

4 Ninety four irradiated and mated animals lived for a period of 4 or more months. Forty one per cent of these remained sterile

5 Of the animals receiving less than 450 millicurie hours of irradiation over each ovary, only 14 per cent remained sterile, while exposures of 450 millicurie hours or more over each ovary resulted in permanent sterility in 74 per cent. Those animals which died within 4 months of mating time are not included in these two groups

6 Of the animals which received 600 millicurie hours or 650 millicurie hours of irradiation and lived for at least 4 months following mating, 66 per cent were sterile. Six hundred and fifty millicurie hours applied to each ovary separately (a total of 1,300 millicurie hours) was the largest dose employed

## CONCLUSIONS

1 With the technique and amount of radium irradiation employed in the present study, it was found to be impossible to sterilize 100 per cent of the animals

2 Radium exposure of the rats' ovaries, in amounts not quite large enough to kill the animals, will probably sterilize between 60 and 75 per cent of them

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A RÉSUMÉ OF THE OSTEochondritides<sup>1</sup>

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**S**TARTING with Muller in 1888, various writers have described a number of conditions which are now looked upon as being fundamentally similar processes with similar characteristics occurring at different growth periods. These conditions are collectively grouped under the term osteochondritis which is taken to signify a non-inflammatory derangement of the normal process of bony growth occurring at the various ossification centers at the time of their greatest developmental activity.

Muller is credited with being the discoverer of epiphyseal coxa vara or displacement of the capital epiphysis of the femur. In 1903 Osgood and Schlatter independently described what is commonly known as Osgood Schlatter's disease of the tibial tubercle. Koehler's disease of the tarsal scaphoid (16) was described in 1908. In 1910 Legg (18) and later in the same year, Calvé (6) and Perthes, independently noted an affection of the femoral head which is variously called Legg's disease, Perthes' disease, Calvé Legg Perthes' disease, osteochondritis deformans juvenilis coxae, capital coxa vara, or coxa plana. In 1914 Freiberg described an infraction of the head of the second metatarsal bone, and Koehler (17) wrote in 1924 on the same condition which has since been known as Koehler's disease of the second metatarsal bone. Vertebral epiphysitis was described by Scheuermann in 1921, by Delahaye in 1924, and by the present writer (3, 4) in 1925. In 1925 Calvé (7) noted two cases of a peculiar affection of the vertebral body. Three cases were added by the author (5) in 1927 under the title "Osteochondritis of the Vertebral Body." During the last decade similar conditions have been found to occur at practically every ossification center that is subject to stress and strain. Among these are included the sternal end of the clavicle (11), the acromion, the coracoid process of the scapula, the head of the humerus (20), the internal epicondyle of

the humerus (19), the olecranon (25), the heads of the metacarpal bones (23), the iliac crests (3), the pubic bones (37), the ischial tuberosity (38), the greater and lesser trochanters of the femur (25), the patella (14), the upper end of the tibia (30), lower ends of the tibia and fibula (35), the os calcis (34), the astragalus (26), the base of the fifth metatarsal, the heads of the metatarsal bones (10, 16, 24), and the sesamoids of the big toe (36).

That all of the separately described conditions are manifestations of a systemic affection is now generally agreed upon. Hartley states: "It is interesting to note that each lesion is associated with a definite age period and in each the age period is that in which the affected bone nucleus normally is actively developing." Christie is of the opinion that no epiphysis in the body is immune to the disease and that it is the same pathological entity modified only by the particular location. Clinically there are a number of cases on record in which a multiplicity of lesions was noted. I have seen a considerable number of instances in which more than one lesion existed. In one case that came under my observation there was an involvement of several of the vertebral bodies in the dorsal region, practically every superior and inferior vertebral epiphysis, the femoral heads, the greater and lesser trochanters, the lower ends of the tibiae, both astragali, and in the shoulder region the coracoid process and the acromion.

It will be impossible, in the space allotted me to go into a detailed discussion of the various etiological theories that have been propounded and which were fully discussed in my previous communication. I will, therefore, limit myself to the additional data that has been accumulated on this phase of the subject. Suffice it to say that tuberculosis and syphilis have been definitely ruled out as etiological factors.

<sup>1</sup>Read before the Orthopedic Section, New York Academy of Medicine, March 15, 1929.





Fig 1 (left) Caisser's Osteochondritis of the sixth seventh and eighth dorsal vertebral bodies. A 3 year old girl fell three months previously a distance of 25 steps. Mother noticed poor posture. Physical examination shows a slight knuckle formation at the level of the sixth dorsal vertebra. No pain no tenderness no limitation of motion. X ray shows a thinning of the vertical diameter of the bodies of the fifth sixth seventh and eighth dorsal vertebrae and a widening of the intervertebral spaces.

Fig 2 (left) Lateral view of patient shown in Figure 1. Note kyphosis in mid-dorsal region flattening and wedging of the fifth sixth seventh and eighth dorsal segments. The seventh dorsal vertebra presents irregular outlines. The intervertebral spaces are comparatively wider than those in the unaffected areas.

A number of writers have suggested late rickets as a cause of this disturbance. In an unpublished study of over 50 cases of various forms of osteochondritis I have found a normal phosphorous and calcium content of the blood serum. In 12 of these the potassium, the magnesium, and the sodium content of the serum was normal. Clinically and roentgenographically there is no evidence whatsoever of rickets.

The theory of endocrine dyscrasia is purely an assumption, for the great majority of the cases do not present any evidence of endocrine dysfunction. The frequency of cervical coxa vara in those affected with Froehlich's syndrome is merely coincidental and is the result

of the increased stress and strain caused by an increase in body weight on the femoral capital epiphysis, the attachment of which is weakened by physiological changes occurring at this time, namely rapid growth atrophy of the periosteum of the neck, and increasing obliquity of the epiphyseal line.

The infectious theory has only in its favor the observation that several surgeons have at operation, obtained positive cultures. This however, has been in the main discounted by the numerous sterile cultures and the absence of any evidence of inflammatory reaction on microscopic examination. None of these conditions have been known to suppurate.

Von Arxhausen's theory of aseptic embolism necrosis and minute compression fractures resulting from slight traumata has been discounted by many writers. It seems inconceivable that these processes should always occur at given age periods in given locations. Just why embolism should occur in the spines of otherwise healthy individuals first during the first few years of life and then after a quiescent period recur during the second period of rapid growth is difficult to explain by this hypothesis. Similarly, this theory does not account for bilateral lesions one sees in cervical and epiphyseal coxa vara, or in tibial apophysitis. Furthermore, the pathological changes are not wholly explainable on this basis. If it be granted that there is embolism in the terminal vessels of the capital epiphysis in Legg's disease, how can the concomitant pathological changes noted in the femoral neck be explained? It is rather far fetched to explain the widening of the femoral neck in the last mentioned condition on the basis of embolism necrosis, and comminuted fractures.

Trauma plays an important part in the causation of these disturbances. Mau (21) has pointed out that rapidly growing bone cells are physiologically weak. If, at the time of rapid growth a static imbalance occurs resulting either from an increased stress or strain or a decreased capacity to withstand stress or strain a derangement of the normal process of growth occurs giving rise to compression fractures and irregularities in growth. Schmorl and Harrenstein have independently



Fig. 3



Fig. 4



Fig. 5

Fig. 3 Case 2 Osteochondritis of the superior and inferior vertebral epiphyses and bilateral epiphyseal coxal varus. Poy age 15 Iroehlich type—weight 170 height 5 feet 7 in.—presents moderate limitation of abduction and extension of both hips. X ray shows widening and mottling of the epiphyseal line the femoral head in the early stages of slipping the upper border of the neck is continuous with the head. The opposite hip presents the same picture.

Fig. 4 Case 2 Back negative clinically Anteroposterior view of the spine shows narrowing of the intervertebral spaces in the dorsal region and irregularities of the vertebral outlines.

Fig. 5 Case 2 Lateral view of the spine showing wedging and moth eaten appearance of the bodies laminae and fragmentation of the superior and inferior epiphyses and mottling of the intervertebral spaces.

shown that an overload on the spine causes flattening of the intervertebral discs with tension on its fibrous walls. Because of its tension the cartilaginous cells of the intervertebral discs proliferate break through and grow into the epiphyseal cartilages and invade the vertebral bodies. When this occurs before growth is completed the possibilities of deformed growth with resultant kyphosis and scoliosis become very likely. More recently Mau (72) has succeeded in producing in the tails of white rats by suturing them subcutaneously to the abdomen a condition similar, in all respects to the vertebral epiphysitis.

Though it must be admitted that the etiological and pathogenic conceptions of osteochondritis are still somewhat indefinite yet one is forced to admit that trauma in the form of increased stress and strain is in all probability a very important factor. Clinically the condition exists at all bony nuclei subject to stress and strain.

The pathology of osteochondritis is not very well established. As stated above, Schmorl and Harrenstein have found in vertebral epiphysitis that there is an invasion and proliferation of cartilage in the vertebral body

and a breaking up of the epiphyseal cartilage. Key in summarizing the pathology noted in



Fig. 6 Case 3 Osteochondritis of the superior and inferior vertebral epiphyses (vertebral epiphysitis). A 14 year old girl showing wedging and a moth eaten appearance of the vertebral bodies, thickening irregularity and fragmentation of the superior and inferior vertebral epiphyses.



Fig 7 Case 4 Osteochondritis of the tarsal scaphoid (Koehler's disease) A 3½ year old boy complaining of pain and swelling over the scaphoid Earlier X rays negative Present roentgenogram shows thinning irregularity and increased calcification of the scaphoid



Fig 9 Case 6 Osteochondritis of the femoral capital epiphysis (Legg's disease) A 4 year old girl complaining of a slight limp Physical examination is practically negative save for a slight limp and a slight limitation of abduction and internal rotation Roentgenogram shows an increased and cloudy joint space a flattened fragmented thinned and intensely calcified femoral head a widening of the epiphyseal line and a thickening shortening and mottling of the neck of the femur



Fig 8 Case 5 Bilateral osteochondritis of the tibial apophysis (Osgood Schlatter's disease) A 12 year old boy complaining of pain and enlargement of the tibial tubercle Roentgenogram shows rarefaction mottling irregularity and fragmentation of the tibial tubercles

cervical coracoclavicular, found that in the early and moderately advanced cases there were islands of cartilage just distal to the epiphyseal cartilage and that with an increased severity of the condition, as seen roentgenographically, there was an increase in hemorrhagic and necrotic areas with fibrous replacement of bone and marrow. Similarly we find that Zemansky, in speaking of Legg's disease, found reports of islands of cartilage in the capital epiphysis in the early cases. Later subchondral hemorrhage necrosis destruction of the epiphyseal line, fragments of dead bone surrounded by vascular granulation tissue and fibrous tissue replacement become the predominant characteristics.

Mau (22) has found in his experiments with the tails of rats, that under the influence of abnormal pressure, changes occur in the endochondral ossification zone the diaphysis, and most especially in the epiphysis. The epiphyseal cartilage reacts by an irregular widening of its cartilage proliferating zone. The diaphysis reacts by an increase of spongy bony growth on the concave side and absorption and fibrous tissue formation rich in giant cells on the convex side. The epiphysis disappears on the concave side. In those epiphyseal areas in which the circulation is

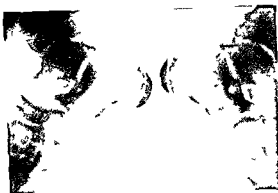


Fig 10 Case 7 Osteochondritis of calcaneal apophysis. A 11½ year old boy complaining of pain and swelling of the left heel. Examination shows tenderness and swelling of the left heel posteriorly while the right heel is negative. X ray shows an intense calcification of the apophyses of both os calcis bones and waviness widening and irregularity of both epiphyseal lines.

sufficient, the reaction consists of a lamellar deposit of bone while in those areas which have an insufficient circulation there is an absorption and even total necrosis of bone and marrow.

The pathology of the other forms of osteochondritis has not been sufficiently described for us to enter into discussion at this time. It is, however, to be noted that in those forms that have been described there is a destruction of the epiphyseal cartilage and islands of cartilage are found in the already ossified areas. As the condition advances hemorrhage and necrosis—evidence of trauma—become more and more marked. Undoubtedly the variations described can be explained only by the various stages of the derangement and the superimposition of trauma. Amaldi found in a case of Osgood Schlatter's disease an irregular endochondral ossification and a formation of osteoid tissue.

Clinically there is a very marked parallelism in the symptomatology of all of the various osteochondritides. As a rule, the patient is in good general health and is practically never acutely ill. All of the symptoms are mild. Occasionally these conditions are symptomless and are discovered only because of developing deformities. At times the affection may be bilateral and only one side may give symptoms. The clinical picture is almost always mild compared to the pathological picture as



Fig 11 Case 8 Osteochondritis of the superior and inferior vertebral epiphyses (vertebral epiphysitis). A 17 year old boy complaining of pain in the back. Examination shows tenderness over the spinous processes of the lumbar vertebrae. Abdominal palpation causes pain in the region of the spine. X ray shows moth eaten appearance of anterior portions of the first second third and fourth lumbar vertebrae.



Fig 12-13 Case 9 Osteochondritis of the superior and inferior vertebral epiphyses (vertebral epiphysitis). A 21 year old girl complaining of pain in the interscapular region for the past two and a half years. Examination shows a hollow round back. X ray. The anteroposterior view shows haziness and indistinctness of the vertebral outlines and narrowing of the intervertebral spaces from the sixth down to the tenth dorsal vertebra. The oblique lateral view shows a moderately increased dorsal kyphosis. The seventh dorsal vertebra is wedge shaped. The sixth and seventh dorsal bodies are eroded and the vertebral outlines are intensely calcified. The inferior epiphysis of the seventh dorsal body is thickened and irregular.

shown by the X ray. The onset is usually gradual and there may, or may not be a history of injury which, if present is most commonly slight. The age of onset is parallel with the age of most active growth of the affected area. Involvements of the centrum of the vertebra occur in the first few years of life. When the superior and inferior vertebral epiphyses are affected, the age incidence is ten to twenty one. Legg's disease occurs most commonly between the ages of 3 and 10 while the slipping of the femoral capital epiphysis occurs rarely before 10 years of age. Osgood Schlatter's disease occurs at 13 to 15 years of age. Koehler's disease of the tarsal scaphoid occurs between 3 and 15 years of age. Apophysitis of the os calcis occurs between 9 and 13 years of age. Koehler's disease of the metatarsophalangeal joint occurs between 10 and 18 years of age.

The roentgenographic appearance of the various forms of osteochondritis is very similar. They all present a widening of the epiphyseal line. There are areas of rarefaction and condensation and the outlines are indistinct giving the entire picture a hazy, mottled appearance. Following this, the bony areas become moth eaten and the outlines of the already ossified bony portion become irregular. When the reparative processes set in there is condensation and reformation of the lamellar structures. The gross deformities however, remain. The type of deformity produced varies with location of the lesion and the treatment instituted.

In view of our comparatively meager knowledge of etiological pathogenic and pathological factors involved treatment must perforce be symptomatic. All of these derangements are self limited and are terminated on completion of ossification. I doubt if with our present knowledge, we can shorten the course of these affections. Our greatest hope is in the prevention of deformity. With early recognition of these conditions pain whenever present can be alleviated, and deformity can practically always be prevented. To that end measures are instituted to rest the parts involved and to diminish all stress and strains on these parts. So that, as soon as the diagnosis is established, we must advise rest of the

affected parts. This will relieve the discomfort. If deformity is present it should be corrected immediately. Treatment should be continued until ossification is complete.

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## AUTO BLOOD TRANSFUSION IN GYNECOLOGY

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IN the literature of blood transfusion I have found several references to the replacement of blood, in a case of ruptured spleen, by British surgeons in India some fifty years ago. I have not been able to find the name of the surgeon or surgeons, and I do not know whether this measure was employed in more than one instance. It would seem probable that the conception of reinfusing blood lost by hæmorrhage was known in England at that time, for there is an article in the *London Lancet* in 1874 by Mr William Highmore, F.R.C.S., senior surgeon to the Yeatman Hospital in Sherborne, suggesting that blood might be reinjected after hæmorrhage and saying that he had lost an obstetric case by hæmorrhage and that in a similar case he would collect the hæmorrhagic blood of the woman and "after it was defibrinated and warmed to the proper temperature by a clinical thermometer over a hot water bath he would inject it with a Higginson syringe and transfusion pipe." Kubanyi, of Budapest says that the idea of auto blood transfusion originated with William Highmore. The practical application of this suggestion must have taken place not long after, for in the *Edinburgh Medical Journal* in 1885-1886, A. G. Miller, F.R.C.S., surgeon to the Royal Infirmary and lecturer on surgery in Edinburgh reports a "case of amputation at hip joint in which re-injection of blood was performed and rapid recovery took place." Two extremely interesting articles by Dr Duncan on auto blood transfusion in amputations are in the British medical journals of 1885 and 1886. Dr Duncan in his first report says that the importance of a few ounces of blood in cases of collapse can hardly be overestimated. He added 5 per cent of phosphate of soda 1 part to 3 of blood, a method which he said was first used by Braxton Hicks on the recommendation of Dr Pary. The second paper contains a word of caution not to "neglect stringent precautions needful to avoid the contingencies of septicity and embolism, lest it should fall into discredit

from too wide an application." He adds "I advocate it as perfectly sane and capable of saving many lives in the major operations of surgery. I make it a routine practise in all the larger amputations because there is no risk and every ounce of blood is serviceable to my own mind the principle of reinfusing the patient is now definitely established." In spite of the favorable results obtained the "re infusion" of blood seems not to have been widely practised in England as few references to it occur later.

The recent use of a patient's own blood for an infusion dates from 1914, when Johannes Thies, of Leipzig re injected the blood in three patients each one of whom had had a severe abdominal hæmorrhage following a ruptured tubal pregnancy and each patient made a good recovery. Thies had previously examined bacteriologically several specimens of blood taken from the abdominal cavity in similar cases of hæmorrhage and had found the blood to be sterile and the red cells uninjured. In the first case salt solution was mixed with the blood in the proportion of 3:2 and the solution was given in the thigh. In the second case it was given in a vein in the arm and in the third case in a vein in the omentum. Thies reports these three cases in *Zentralblatt fuer Gynaekologie*, 1914 but was unable to continue as he was soon called to the front where he remained as assistant surgeon throughout the war. Auto blood transfusions were performed however in the Leipzig clinic by Lichtenstein, who reported in 1915 that eight more patients had had auto blood transfusions for hæmorrhage in ruptured tubal pregnancy with excellent result in each case. In 1918 and 1919 Lichtenstein described the technique which he had now used successfully for 39 cases and said that now "no woman operated upon because of tubal rupture ought to die from hæmorrhage without an auto blood transfusion." The method was now being used in several gynecological clinics in Germany with nearly universal approval. In

1910 Doederlein wrote enthusiastically of the result in 5 cases of his, giving to Thies the credit for the discovery of the method which he says is so strikingly simple and so wonderful in its results. Goder quotes Doederlein as saying that many certainly hopeless cases had been completely restored to life by auto blood transfusion. From this time on there were frequent reports in German literature of transfusing a patient with her own blood following an abdominal hæmorrhage from tubal pregnancy.

Writers differ, however, as to the term to use to describe this measure. In 50 reports 32 of the writers employ the words "auto blood transfusion," 9 use the term "auto blood infusion" and the other 9 call the practise a "re infusion." This seems a needless confusion of terms. Webster defines the term transfusion as follows: "To pour out of one vessel into another." If to transfusion we apply the prefix auto blood (meaning a patient's own blood returned to his circulation after a hæmorrhage), we have a term that describes the transfusion and also differentiates it from the donor blood transfusion.

The first account that I have found of auto blood transfusion in this country was made by White<sup>1</sup> November 29, 1920. The patient suffered from a ruptured liver and was given 500 cubic centimeters of his own blood (cit rated). He made a good recovery. White used a Balfour aspirator to collect the blood and states that he had only two reactions in this and the five transfusions made subsequently.

Davis in 1922-1923 reports a case in which 600 cubic centimeters of his own blood was given in September, 1922 following a punctured wound of the spleen. The next report is in SURGERY, GYNECOLOGY AND OBSTETRICS in 1923 by Burch who made an auto blood transfusion in 1922 after removing a spleen. He states that he has used this measure successfully in 3 other cases—2 ruptured tubal pregnancies and 1 nephrectomy. Burch gives a bibliography and résumé of many of the early cases. He says that since 1914, 164 cases of auto blood transfusion have been reported in European literature but only 4 were reported from outside Germany. Two deaths occurred

one from a technical error, one from hæmoglobinuria. In conclusion Burch says that he believes that auto transfusion is a most valuable procedure in certain cases. This same year, also in SURGERY, GYNECOLOGY AND OBSTETRICS, Sir William Taylor, regius professor of surgery in the University of Dublin, describes on the editorial page of the September number his "Auto Infusion of Blood from the Spleen in Cases of Splenectomy," and Dr. William J. Mayo in another editorial that month, in writing of a visit to Dublin, says that Sir William immediately transfuses to the patient the free blood in the spleen. The next report of the use of a patient's own blood for transfusion is the extremely interesting account by Dr. Harvey Cushing at the Peter Bent Brigham Hospital and Dr. Loyal Davis formerly Fellow of the National Research Council. Out of 285 major neurological operations in the clinic, blood replacement was carried out 23 times. Briefly stated, the blood was collected by a water suction apparatus, filtered through gauze, and then allowed to flow by gravitation into the basilic vein in the arm. In commenting the writers say "There can be no question however, but that the proportion of these admittedly formidable operations which have required more than one stage for their completion has been considerably cut down by the judicious use of this procedure."

It is a source of comfort to a surgeon, in the emergencies which may arise from an undue lowering of pressures, to know that there is ready at hand an infusion fluid which is fairly rich in the more essential blood elements—a fluid which requires no grouping.

The technique now to be described of collecting a patient's own blood lost during an operation and later returning it to her veins was developed with the idea of salvaging the large amount of fluid blood found in the abdomen at the time of an operation for a ruptured tubal pregnancy. It has always seemed illogical to throw away a patient's blood and then institute a frantic search for a donor to supply blood, for even though the blood is of the same type and is compatible, still we know that a severe reaction sometimes follows. A distinguished pathologist of this city exclaimed

<sup>1</sup>Surg. Gynec. & Obst. 1923 xxvii, 343



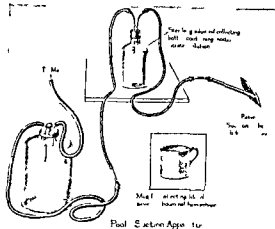


Fig 1

'That is not surgery' when he saw an operator throw away the specimen he had just removed from an abdomen. Perhaps we may say to throw away good blood is not surgery. It seemed that if we had a way to collect and return the blood quickly to the patient's veins that we might not need to make the more difficult blood transfusion and so avoid a reaction that is more apt to follow the injection of a donor's blood than the patient's own blood. The work of Levine and Segall at the Royal Victoria Hospital in Montreal has proved that owing to the changes produced in the blood by the anesthetic reactions more often occur after a blood transfusion given in the first 24 hours following an operation.

For a year I kept in the operating room sealed sterile ampoules of 2 per cent sodium citrate solution ready for an auto blood transfusion in ruptured tubal pregnancy, but the frequent change of personnel in the interne and nursing staffs made it impossible to secure all the help needed for the transfusion when the operation itself demanded my entire attention. I concluded that team work could be attained only by frequent practice of the technique on the simpler cases and arranged to try this measure in clean hysterectomies for myoma uteri. It was a surprise to me to find the transfusion so valuable. I had decided that the suction method we use to collect fluids from the abdomen was the best way to collect the blood flowing into the pelvis as the ladle or cup



Fig 2

which is used for large amounts of blood would be in the way here and sponges should never be used as the squeezing out of the blood injures the red cells. Ten cubic centimeters of sterile 2 per cent sodium citrate solution was placed in the sterile graduated suction bottle and blood drawn to the 100 cubic centimeter mark. (This is the amount, 2 per cent, used by Lichtenstein who has shown by experiment that 5 grains of sodium citrate may be given safely to a patient even though one returned 1000 cubic centimeters of blood to a patient the amount of a 2 per cent solution would be only 2 grains.) The bottle was then removed and a similar bottle containing the same amount of sterile sodium citrate solution was connected and suction begun again. The 100 cubic centimeters of citrate blood was then poured through 20 thicknesses of gauze wet with sterile normal salt solution. The gauze lay on the top of a sterile funnel which was in a sterile flask standing in a bowl of hot water. Five times as much sterile normal salt solution (105 degrees F) as sodium citrate solution (i.e. 50 cubic centimeters) was poured over the blood which was then covered to prevent aeration and allowed to filter. Care was taken not to stir nor shake the blood to avoid injury to the red cells. The blood thus collected was then given by gravity method into the median basilic vein in the arm. (In cases of shock if the veins in the arm are collapsed the blood may be given with a syringe into a vein in the omentum or into the deep epigastric vein in the abdominal wall.) I did not know, until I had given blood to several pa-



Fig 3

tients by this method that Dr Harvey Cushing had collected blood by suction and given it by this same gravity method. In the first cases transfused a specimen of the blood collected by suction was sent at once to the pathologist, who reported in each instance that the erythrocytes had not been injured by the suction method of collecting the blood. The first ten consecutive cases will be reported in the order in which they were operated upon. Auto blood transfusion was planned only for clean cases that had very large myomata uteri and when a difficult operation was anticipated either because of the size or the location of the tumor or some condition of the patient such as obesity or anemia. Gum glucose solution was given in nearly every case as has been my practise for several years when it was especially desirable to maintain blood pressure as in a poor risk patient or in a long operation. Two hundred and fifty to three hundred cubic centimeters of the solution was usually given, and the blood pressure readings were taken just before the patient left the operating room and after the blood had been injected into a vein. As it happened the first case needed the blood transfusion more than I had anticipated.

**CASE 1.** Mrs R. No 42017. Operation November 23, 1928 for a large blood cyst. Numerous coils of intestine were firmly adherent over the tumor. Two hundred fifty cubic centimeters of blood was collected in 25 cubic centimeters of 2 per cent sodium citrate solution and 125 cubic centimeters of normal salt solution were added. The patient left the operating room with blood pressure 124—70, pulse 66, respiration 36. There was no reaction of any kind and the convalescence was absolutely normal. It was a great comfort to know while operating that the blood would be replaced at once and this permitted

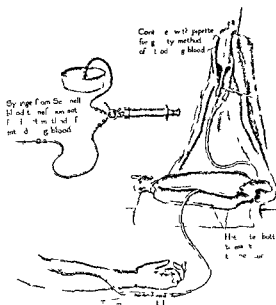


Fig 4

slower, more careful dissection of the intestines from the tumor than would have been justifiable if blood had not been available.

**CASE 2.** Mrs W. No 42110. Operation December 10, 1928 hysterectomy for myoma uteri, the size of a 3½ months pregnancy. As the clotting time was 7 minutes 45 seconds it seemed that an auto blood transfusion might be of help. But the bleeding was slight and only 25 cubic centimeters of blood were collected. This was given together with 50 cubic centimeters of sodium citrate solution. This excess amount of sodium citrate was given by an assistant through a misunderstanding of the technique. The patient left the operating room with blood pressure 122—68, pulse 88, respiration 28. One hour after returning to her room the patient had a slight general tremor and dusky color due I believe to the excess of sodium citrate solution. A hypodermic injection of 1000 cubic centimeters of normal salt solution was at once given. The tremor had subsided before the needles were introduced and the color promptly returned to normal in a few minutes. This was the only case that had any reaction whatsoever following auto blood transfusion.

**CASE 3.** Mrs M. No 40643. Operation January 15, 1929 hysterectomy for vascular myomata uteri, size of 5 months pregnancy. This patient had been transfused several days before the operation because of a secondary anemia and as often happens after a recent transfusion she bled freely. Two hundred cubic centimeters of blood was collected in 20 cubic centimeters of sodium citrate solution and 180 normal salt solution was added. The patient left the operating room with blood pressure 132—68, pulse 96, respiration 28. The blood count is of interest as

it shows no secondary fall in the number of erythrocytes but an appreciable gain a few days after the auto blood transfusion which is contrary to the usual drop seen after donor's blood has been given. The pre operative count taken January 12 1909 (3 days before operation) was 4 500 000 red cells and 76 per cent hæmoglobin, January 16 1909 (5 days postoperative), 3 550 000, 74 per cent hæmoglobin, January 21 1909 (6 days postoperative) 4 000 000 72 per cent hæmoglobin.

CASE 4 Mrs R No 42 255 Patient 46 years old frail type hæmoglobin 40 per cent on entrance to the hospital (after blood transfusions 82 per cent). Operation January 21, 1909 hysterectomy for myomata uteri extending 3 inches above the umbilicus. One hundred seventy five cubic centimeters of blood was collected in 20 cubic centimeters of sodium citrate solution and with 100 cubic centimeters normal salt solution was transfused. The patient left the operating room with blood pressure 150—72 pulse, 100 respiration 28. The convalescence in this case was remarkably smooth for such a frail patient and showed not only a maintenance of the blood but some increase 4 days after operation. The blood count was as follows: January 17 1909 (4 days before operation) 4 450 000 red cells 82 per cent hæmoglobin, January 25 1909 (4 days postoperative) 4 460 000, 80 per cent hæmoglobin.

CASE 5 Mrs B No 42 320 This patient was 50 years old and had a large myoma above the umbilicus a cystocele and rectocele. As the plastic operation as well as the hysterectomy was necessary it was thought best to save as much blood as possible. The hysterectomy proved to be a simple one however and only 30 cubic centimeters of blood was collected in 10 cubic centimeters sodium citrate and saline 150 cubic centimeters, was added. The blood pressure after operation was 110—76, pulse 93 respiration 38.

CASE 6 Mrs M No 33 476 Operation February 18 1909 hysterectomy for an extremely vascular myoma the size of a 5 months pregnancy. One hundred seventy five cubic centimeters of blood was collected in 20 cubic centimeters of sodium citrate solution and 100 cubic centimeters of normal salt solution. The patient left the operating room with blood pressure of 128—72 pulse 120 respiration 28. There was absolutely no reaction and convalescence was smooth except for a mild pyelitis which the patient had had a year previous to the operation. The blood count was as follows: February 27 1909 (the day before operation) 4 840 000 red cells hæmoglobin 83 per cent, March 6 1909 (7 days after operation) 4 480 000 red cells hæmoglobin 83 per cent.

CASE 7 Mrs R No 42 517 This patient was 47 years old. Hæmoglobin was 43 per cent as a result of repeated hæmorrhages. She was transfused twice before operation. Operation February 2 1909 hysterectomy for hyperæmic myomata extending above the umbilicus and into both broad ligaments. The rectum and sigmoid were densely adherent posteriorly and the bladder high on the anterior wall. It

was necessary to split the capsule and shell the tumor out. The abdominal wall was unusually fat. The difficulties of this operation and the vascularity of the tumor made the auto blood transfusion of real value. Two hundred seventy five cubic centimeters of blood was collected to which was added 30 cubic centimeters of sodium citrate solution and 200 cubic centimeters of normal salt solution. The patient left the operating room with blood pressure 150—88, pulse 94 respiration 38. The blood count was as follows: January 28, 1909 (5 days before operation) 4,200 000 red cells 70 per cent hæmoglobin, February 7, 1909 (5 days after operation) 4 150 000 63 per cent hæmoglobin.

CASE 8 Mrs K No 42 852 Operation March 28, 1909 hysterectomy for myoma. The rectum was densely adherent to the tumor. A hæmorrhagic cyst the size of an orange was found in the broad ligament. One hundred twenty cubic centimeters of blood was collected to which was added 20 cubic centimeters of 2 per cent sodium citrate and saline 200 cubic centimeters. Postoperative blood pressure was 135—25. March 24 1909 4 050 000 red cells 72 per cent hæmoglobin (3 days before operation), March 30 1909 3 580 000 red cells 70 per cent hæmoglobin (2 days after operation).

CASE 9 Mrs Y No 42 682 Operation March 14 1909 hysterectomy for myomata uteri the size of a 4 months pregnancy with left broad ligament myoma the size of a golf ball. One hundred thirty five cubic centimeters of blood was collected in 15 cubic centimeters of 2 per cent sodium citrate solution and 140 cubic centimeters normal salt solution was added. Patient left the operating room with a blood pressure 122—86. The blood count was as follows: March 11 1909 4 850 000 red cells 85 per cent hæmoglobin (4 days before operation), March 16 1909 4 200 000 red cells 80 per cent hæmoglobin (1 day after operation), March 18 1909 3 590 000 red cells 75 per cent hæmoglobin, March 20 1909 3 890 000 red cells 75 per cent hæmoglobin.

CASE 10 Mrs C No 42 740 Operation March 26, 1909 hysterectomy for myoma the size of a 4 months pregnancy with a myoma filling Douglas cul de sac and a parovarian cyst the size of a grape fruit. There was very little bleeding and only 13 cubic centimeters of blood was collected to which was added 10 cubic centimeters of 2 per cent sodium citrate 100 cubic centimeters saline. Blood pressure 144—96. Blood count March 18 1909 4 200 000 red cells 81 per cent hæmoglobin.

Of these first 10 cases to whom auto blood transfusion was given because of anticipated bleeding, 3 lost only a negligible amount of blood—15 to 30 cubic centimeters—4 lost from 120 cubic centimeters to 175 cubic centimeters and 3 lost from 200 cubic centimeters to 275 cubic centimeters. It is not in the least likely that any one of the patients would have

died without this transfusion but for Cases 1 and 3 I might have ordered a donor blood transfusion and I certainly would have for Case 7. The convalescence was so smooth for every patient it was a pleasure to see the result. It is of interest to note that 3 patients receiving 175 to 275 cubic centimeters of blood had no secondary fall in red cells as commonly occurs after a donor blood transfusion. The first and sixth patients unfortunately did not have a count made early enough to show whether this would have been so or not.

CASE 11 Mrs P, No 42 768. Reported through the kindness of Dr Ward. This was a diabetic patient with a mild anemia who had a fibroid extending to the umbilicus and pressure symptoms necessitating its removal. Operation March 22 1929 hysterectomy. One hundred forty cubic centimeters of blood was collected and 20 cubic centimeters 7 per cent sodium citrate and 300 cubic centimeters normal saline were added. The patient was in such an absolutely satisfactory condition at the end of operation that the donor blood transfusion, which had been ordered, was deferred until 24 hours later to avoid a possible reaction due to changes in the blood produced by the anæsthetic. The blood count was as follows: March 19 19 9 3 850 000 red cells 65 per cent hæmoglobin. March 23 1929 blood transfusion 500 cubic centimeters donor blood. March 25 1929 4 600 000 red cells 86 per cent hæmoglobin.

CASE 12 Mrs K, No 42 694. I am reporting this case with the kind permission of the surgeon who is on the courtesy staff of the hospital. The patient was taken to the operating room because of a secondary hæmorrhage. It was impossible to get the blood pressure when she arrived there. The abdomen was tensely distended with large amount of fluid blood and clots. The fluid blood (400 cubic centimeters) was aspirated from the abdomen, citrated, filtered and mixed with gum glucose solution and preparation made for infusion into a vein in the arm. As the patient's veins were completely collapsed it was necessary to cut down on the vein before the needle could be introduced. The bleeding point was clamped and at the same moment the patient ceased breathing and was pulseless. Adrenalin was immediately administered and artificial respiration begun. By this time the infusion started and as the infusion solution entered the circulation the pulse promptly responded. The wound was closed and on the arrival of the donor 500 cubic centimeters of blood was given to the patient in the other arm. She left the operating room with a blood pressure of 126—70 and made an excellent convalescence. Four hundred cubic centimeters auto blood was transfused together with 225 cubic centimeters gum glucose solution. The blood count was as follows: March 11 1929 (1 day before the first operation)

4 650 000 red cells 85 per cent hæmoglobin, March 13 19 9 after 400 cubic centimeters auto blood transfusion, 500 cubic centimeters donor blood transfusion, 4 000 000 red cells, 70 per cent hæmoglobin.

The surgeon told me "There was absolutely no pulsation in the abdomen when the infusion started" and that he believed "the patient never would have recovered without the gum glucose solution and auto blood transfusion."

The technique could not have been carried out in such a grave emergency if the staff had not been trained to team work in the simpler cases. One such patient saved would be well worth the time and effort spent to train the interne and nursing staff.

Very little equipment is needed. Every operating room should have a suction apparatus to collect fluid. It need not be an expensive electric driven motor as tubing connected to a double faucet produces sufficient suction by means of running water. Sealed sterile ampoules of 2 per cent sodium citrate solution are not expensive and keep indefinitely. *Team work is essential.* It is necessary not only to explain the technique to the staff but they must practise it often enough on simpler cases so that in an emergency operation they are competent to make the transfusion without instruction from the operator. The order "auto blood transfusion" ought to mean the suction tube in the abdomen and citrate solution in the graduated bottle ready to begin suction 2 minutes after the order is given. An auto blood transfusion does not interfere in the least with the operation. The sterile suture nurse changes the bottles and filters the citrated blood. The second assistant manages the suction tube and can drop out at the end of the operation and inject the blood, or a third assistant can give the blood during the operation if desired. If he has been giving gum glucose solution the blood is simply poured into this. In teaching the staff one should caution them:

- 1 Never use stagnant or clotted blood or blood if there is any suspicion of infection in the pelvis or abdomen.

- 2 Ten cubic centimeters of a sterile 2 per cent sodium citrate solution should be used with each 90 cubic centimeters of blood to prevent coagulation, and 5 times as much

sterile normal salt solution should be used as sodium citrate solution—more salt solution may be added if desired to offset the loss of body fluids

The advantages of an auto blood transfusion are

1 It lessens or prevents shock by supplying immediately blood to the circulation at a time when every ounce of blood counts

2 It obviates the delay necessary to find a donor and type and match the blood

3 It supplies a compatible blood and thus avoids a reaction due to the incompatibility of the donor's blood with the recipient resulting from changes in the recipient's blood produced by the anæsthetic

4 The ease and simplicity of this method makes it possible to give it to patients for whom one would hesitate to order a donor blood transfusion

#### CONCLUSIONS

1 Auto blood transfusion may be a valuable aid in difficult clean pelvic operations associated with hæmorrhage

2 Auto blood transfusion may be a life saving measure in emergencies if the interne and nursing staff are thoroughly trained to carry out this technique in the simpler cases

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## BILE LEAKAGE FROM THE CYSTIC DUCT FOLLOWING CHOLECYSTECTOMY

### AN EXPERIMENTAL STUDY OF THE OBLITERATION OF THE CYSTIC DUCT STUMP<sup>1</sup>

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A MOOT subject in gall bladder surgery which has attracted much comment is the matter of drainage after cholecystectomy. Many surgeons insist upon routine drainage while others not only do not drain but consider the act unnecessary and possibly harmful. Between these extremes must lie a meridian of scientific accuracy which might be determined if we knew what reparative or retrogressive changes take place in the structures involved in the operation.

An analysis would indicate that there can be three possible reasons for drainage: infection, hemorrhage, and bile leakage. Most surgeons, I believe, are agreed that when an acute infection is encountered, such as gangrene with local peritonitis, drainage is not only safe but desirable. In those cases in which oozing from the liver bed cannot be controlled with compression, fat packs, or ligation, a gauze compress for 24 to 48 hours is necessary. These two conditions rarely cause adverse comment. In bile leakage we find the basis for most of the conflicting opinions. Viayazo (4) endeavored to prove that any opening in the gall bladder or ducts would very soon become occluded by omentum or other neighboring structures and that in the experimental animal, death due to bile leakage was never encountered. In some later experiments (5) his opinion was materially changed. Richter from clinical experience only disproves of drainage on the assumption that bile is not toxic and will do little harm if allowed to flow into the peritoneal cavity. This is disproved by the studies of Horrall and Still who have shown, it seems without doubt, that bile especially the choleic salts, are intensely toxic and that 5 cubic centimeters of bile per kilogram of body weight if injected into the peritoneal cavity of the dog will cause death quite promptly.

Clinical histories indicate that not infrequently after a cholecystectomy bile appears in varying quantities in the upper abdominal cavity. A careful investigation would lead one to believe that the bile may find its way into the peritoneal cavity in several ways. In the delivery of the liver, tears of the liver parenchyma may involve small biliary ducts and subsequently there may be a moderate amount of bile leakage. The amount will depend upon the number and size of the ducts injured and the possibility of rapid repair. Occasionally, small accessory ducts may lead directly from the liver substance or the hepatic duct into the gall bladder, thus there may be leakage from the gall bladder bed. I have seen several instances in which fair sized ducts entered the fundus of the gall bladder near its tip. These discharged sufficient bile to be noticed at the time of the operation and were ligated. Injury to the major ducts either common or hepatic may lead to secondary or delayed biliary drainage. Most diversities of opinion seem to evolve about the possibility of cystic duct leakage.

On the assumption that the ligature may slip off, cut through or for sundry other reasons, a number of procedures have been advocated for special ligation of the cystic duct. In searching the literature only one reference could be found which pertained to the repair or change in the cystic duct after cholecystectomy. Hofmann described an obliterating process in the cystic duct which is different from that found in blood vessels after ligation, but his statements were not verified by animal experiments or studies of human specimens.

It occurred to me that a carefully planned experimental study of the changes in the cystic duct after cholecystectomy in the dog might answer the question of bile leakage, at least so far as the cystic duct is concerned.



Fig 1 Low power photomicrograph showing cross section of ligature surrounded by the exudate. The constricted area of the duct lies below the ligature. The area to the right is the proximal portion of the duct (Day 1)

A series of 46 dogs were subjected to cholecystectomy. All animals received preoperatively morphine and atrophine and were operated upon under ether anaesthesia, strict aseptic technique being used. In the earlier experiments catgut was used for the duct ligature later silk was employed because, in the process of formalin or Zenker fixation of the duct specimen the catgut became so hard that when sections were cut the hardened gut would tear through the section before it was completely cut by the microtome knife, thus many valuable sections were destroyed. Moreover in the late specimens, 15 to 33 days the area of ligation was often uncertain because of the disappearance of the gut. The cystic artery in most instances was ligated well proximal to the site of the duct ligation.

It is well to call attention to certain anatomical differences in the biliary passages of the dog and man. These differences I believe are important so far as the process of repair is concerned. In the dog the cystic duct is almost completely surrounded and closely enveloped by the tough fibrous serosa and in doing a cholecystectomy it is unnecessary in fact impossible to separate this coat from the muscular wall. In man the cystic duct lies between the folds of the duodenohepatic ligament and in doing a cholecystectomy the margins of the ligament are divided and the



Fig 2 Photomicrograph showing the nature of the exudate. In the center many red blood cells can be seen. The darker areas are essentially leucocytes. 245 diameters (Day 1)

duct is separated from its peritoneal investment before ligation. In the dog the cystic artery lies anterior and usually just above the cystic duct and sends small branches to the duct through the peritoneal investment. It can often be ligated with little disturbance in anatomical structures. In man as is well known the artery can be found only after rather tedious and liberal dissection of the border of the duodenohepatic ligament and in most instances is found passing at an angle



Fig 3 Photomicrograph taken of the zone within the group of the ligature showing the elongation and compression of the nuclei. 275 diameters (Day 1)





Fig 4 Low power photomicrograph through the zone of ligation. The area to the right is the proximal side of the duct. This demonstrates the disappearance of the mucous membrane beneath and distal to the ligature also the loss of normal structure in the distal portion of the duct (Day 2)

downward anteriorly, and to the left to lie behind or to the right of the cystic duct and gall bladder neck.

Specimens of the ligated cystic duct of the experimental animal after cholecystectomy were studied at intervals from 1 to 33 days. In some instances portions of the adjacent liver were removed with the adherent duct *in situ* and the whole was fixed and serial sections were cut. There was some variation



Fig 6 Low power photomicrograph at the zone of ligation. This demonstrates the necrosis beneath and distal to the ligature also the definite zone of necrosis proximal to the ligature. The area to the right is the proximal portion of the duct (Day 3)



Fig 5 Photomicrograph showing necrosis with leucocytic and red blood cell infiltration in that portion of the duct distal to the ligature. 2,3 diameters (Day 2)

in both gross and microscopic findings at the various periods. An explanation for these differences will be offered later.

**DAY 1** The stump of the duct was uniformly buried by the lobes of the liver. Upon separation of the liver lobes the duct was found adherent to the liver structure and an exudate of variable amount covered the interstices about the duct especially the ligature (Fig 1). One animal No 68 died at the end of 24 hours and at autopsy the peritoneal cavity was found filled with a bile stained fluid and a perforation was found just proximal to the ligature. This perforation as no doubt produced by an attempt to strip the serosa from the duct at the time the cholecystectomy was performed. This was done in an effort to study if possible the repair of the duct deprived of its peritoneal coat.

**Microscopical findings** The exudate was a homogeneous mass consisting of red blood cells, coagulated lymph and serum rich in leucocytes (Fig 2). This mass was closely adherent to the duct and invariably buried the ligature and surrounding duct tissues. It stripped easily from the duct. Under the ligature the cells were compressed and the nuclei were elongated (Fig 3). Distal to the ligature the cells were degenerating, the nuclei were less distinct and there was extensive red blood cell and leucocytic infiltration. Proximal to the ligature for a short distance fewer nuclei were to be seen with also extensive red blood cell and leucocytic infiltration.

**DAY 2** The exudate was a trifle more brittle than on the previous day and still stripped readily from the duct. Otherwise the gross findings were essentially the same as on the preceding day.

**Microscopical findings** The exudate contained considerable cell debris with many red blood cells



Fig 7 Low power photomicrograph at the zone of ligation This again shows the zone of proximal necrosis (Day 4)

and polymorphonuclear leucocytes *Duct* Under the ligature the nuclei although thinned and elongated still stained fairly well In a number of specimens there was beginning leucocytic infiltration of this zone Distal to the ligature there was diffuse and very extensive leucocytic infiltration with many red blood cells present The mucous membrane was beginning to disappear and the nuclei of the fixed cells stained less clearly (Figs 4 and 5) Proximal to the ligature was extensive red blood cell and leucocytic infiltration and for several millimeters the nuclei of the fixed cells stained less definitely The mucous membrane in this area had also disappeared

**DAY 3** The exudate was more firm and adherent both to the duct and adjacent liver tissue although the duct still shelled out quite readily

*Microscopical findings* The exudate consisted of much cell debris and leucocytes and embryonic connective cells were appearing at the zone of contact with the duct wall and liver edge *Duct* Under the ligature the nuclei still took the stain and there was some leucocytic infiltration In some areas the cells were fragmented and the nuclei had disappeared Distal to the ligature in some specimens there was almost complete necrosis of the duct wall with extensive leucocytic infiltration (Fig 6) In other specimens there was less necrosis and there still remained many viable cells the nuclei of which stained fairly well Proximal to the ligature for several millimeters many specimens showed necrosis with leucocytic infiltration The distance the proximal necrosis extended varied in different specimens The leucocytic infiltration extended well beyond the zone of necrosis

**DAY 4** The gross appearance was not unlike that of the previous day

*Microscopical findings* The exudate was essentially like that of the third day with perhaps more young connective tissue cells present *Duct* In some specimens the distal part of the duct contained many viable mature cells with islets of mucous membrane intact Invariably there was extensive leucocytic infiltration In other specimens there was almost complete necrosis with leucocytic infiltration



Fig 8 Photomicrograph demonstrating leucocytic infiltration and necrosis proximal to the ligature 250 diameters (Day 4)

Necrosis proximal to the ligature was uniformly present (Figs 7 and 8)

**DAY 5** The exudate was rather brittle and clung more closely to the duct and liver tissue The duct at the site of ligation was very friable and would break asunder with the slightest trauma In animals No 59 and 61 the duct broke off at the site of ligation even though great caution was exercised in its removal

*Microscopical findings* The exudate adhered rather closely to the duct wall and contained many young connective tissue cells These cells for the most part lay in the zone of exudate which was adjacent to the duct wall or liver tissue *Duct* Viable cells were still found under the ligature in some of the specimens and here and there a young connective tissue cell would be seen but for the most part the structures within the grasp of the ligature were not viable and consisted essentially of collagen fibers In a number of sections the structures under and about the ligature were fragmented (Figs 9 and 10) Those specimens which broke asunder in their removal showed necrosis with red blood cell and leucocytic infiltration The distal portion of the duct showed areas of necrosis and other areas where the cells were viable There was also evidence of beginning fibrosis The area just proximal to the ligature appeared homogeneous with leucocytic infiltration Some fragmentation was also present (Fig 11)

**DAY 6** The structures were well sealed over and the gross findings were not unlike those of the fifth day The tendency to separation at the point of ligation was also present

*Microscopical findings* The exudate clung closely to the duct wall and often could not be differentiated from the duct (Fig 12) *Duct* In one specimen

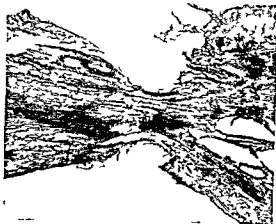


Fig 9 Low power photomicrograph of the zone of ligation. This demonstrates the necrosis beneath and distal to the ligature. It also shows the tendency to fragmentation proximal to the ligature. (Day 5)

there was extensive cellular invasion of the area within the grasp of the ligature (Fig 13). The cells were leucocytes and a few young connective tissue cells. Other findings were essentially as those of the fifth day. In a ruptured specimen, No. 58, the zone of separation contained quite a few young connective tissue cells and leucocytes with red blood cells. Few adult nuclei could be found.

DAY 7 The gross appearance was but little different from that of the several previous days but there was less tendency to break at the point of ligation. The distal portion of the duct showed evidence of fibrosis with extensive necrosis in most instances. This necrosis extended well proximal to the ligature and no evidence of repair could be seen at the site of ligation (Fig 14). The necrotic



Fig 11 Photomicrograph showing the fragmentation proximal to the ligature. 175 diameters (Day 5)

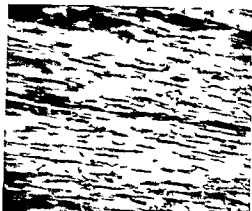


Fig 10 Photomicrograph showing the disappearance of the nuclei beneath the ligature. 275 diameters (Day 5)

areas showed extensive leucocytic infiltration. The exudate was rich in young connective tissue cells which could be seen in large numbers adjacent to the duct wall and liver (Fig 15). These cells seemed more mature in nature than on previous days.

DAY 9 There was little change from conditions as described on the seventh day. In the preparation in which the duct was loosely ligated and leaked with increase of pressure the mucous membrane remained intact under the ligature but the muscular wall had disappeared (Fig 16). This specimen also showed less distal necrosis.

DAY 10 The duct was imbedded in organizing exudate. The exudate contained large numbers of connective tissue cells with less leucocytes and blood channels were forming. The distal end of the duct was undergoing fibrosis. The tissues in the grasp of the ligature were in part fragmented at times being invaded by young connective tissue cells (Figs 17 and 18).

DAYS 11 TO 20 These specimens showed some daily variation but essentially the process was that of organization of the exudate and fibrosis of the duct stump (Fig 19). In many sections extensive necrosis was present. The rate at which the organization or cellular maturation of the exudate took place was variable. In some specimens it was well under way at 11 to 14 days; in others it appeared to be delayed. Distal to the ligature at 20 days areas of necrosis which contained few viable cells except possibly leucocytes could be found in many specimens. One specimen, No. 80 at the 20 day period showed a globular enlargement about 1 centimeter in diameter just distal to the point of ligation (Fig 20). The wall of this cavity was lined in part with epithelium resting on a connective tissue base (Fig 21). It shelled out quite readily from the surrounding tissue. In contrast to this specimen No. 81 at the 22 day period contained a grossly similar distal distention which proved to be very different in character. That part of the duct



Fig. 12 Photomicrograph of the zone of ligation demonstrating proximal and distal necrosis with adjacent exudate which can not be distinguished from the duct wall (Day 6)

showed extensive necrosis and there was no lining epithelium or definite connective tissue wall.

**DAYS 20 TO 33** During this period the exudate showed evidence of further absorption and organization so that the remnant of fibrosed duct became involved in an organizing mass of connective tissue adherent to the adjacent liver (Figs 22, 23, 24 and 25). Areas of leucocytic infiltration with here and there areas of necrosis were still present and the adjacent liver showed areas of leucocytic infiltration in the immediate vicinity.

#### CORRELATIVE OBSERVATIONS

It was observed in a number of the experiments that on about the fifth day after operation, the duct was very brittle and broke

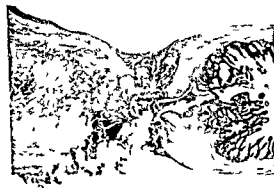


Fig. 14 Low power photomicrograph showing the extensive necrosis beneath and distal to the ligation. This photograph clearly demonstrates that at this period the changes within the duct have not occluded the lumen at the site of ligation (Day 7)



Fig. 13 Photomicrograph depicting the extensive cellular infiltration of the area of the duct within the grasp of the ligature 225 diameters (Day 6)

at the point of ligation. An attempt was made to determine whether the intrabiliary pressure might be sufficient to rupture the duct at this point. In animal No. 65, 4 days after cholecystectomy, the common duct was cannulated and the intraductal pressure was raised to 152 millimeters of mercury. At this level the animal suddenly died. The duct did not rupture at the point of ligation but a small perforation took place about 4 millimeters proximal to the ligature. In this experiment



Fig. 15 Photomicrograph showing young connective tissue cells in the exudate 1200 diameters (Day 7)



Fig 16 Low power photomicrograph of the zone of ligation showing the absence of the muscular coat with the mucous membrane intact (Day 9)

the cystic artery was not separately ligated. In animal No 66 on the fourth postoperative day the same procedure was applied and the pressure was raised to 168 millimeters of mercury with no leakage or rupture of the duct. In this experiment the cystic artery was tied close to the common duct. In animal No 69, 4 days after cholecystectomy, the same experiment was applied with 176 millimeters of mercury pressure and the duct remained intact. In animal No 70, 4 days after operation, 168 millimeters of mercury pressure



Fig 17 Low power photomicrograph through the zone of ligation. This shows a cross section of the ligature on either side with fragmentation of that portion of the duct within its grasp. The ligature and duct are well surrounded by the exudate (Day 10)

was introduced and the duct remained intact. Animal No 73, 5 days after cholecystectomy, withstood 160 millimeters of mercury pressure without rupture of the duct. Animal No 71, on the sixth postoperative day, withstood 170 millimeters of mercury pressure. In animal No 72, 6 days after operation, when the pressure was raised to 66 millimeters of mercury pressure there was leakage at the point of ligation. In animal No 75 the duct was loosely ligated and on the seventh day after operation the intraductal pressure was raised to 66 millimeters of mercury. At this level, leakage took place through the end of the stump. The duct was then freed and the pressure increased with no leakage at the site of ligation but free flow of water from the end. In animal No 74 the duct was also quite loosely ligated at the time of the cholecystectomy and on the ninth postoperative day the common duct was cannulated and when the pressure was raised to 108 millimeters of mercury leakage took place through the end of the duct stump but not at the site of ligation. The duct had not been freed from the exudate. When the specimen was removed for study it was found to contain only a mucous membrane tube at the site of ligation, the outer layers having entirely disappeared (Fig 16).

In several instances gauze drains were inserted to the ligated duct and were removed on the third postoperative day. Invariably these specimens showed excessive adhesions



Fig 18 Photomicrograph showing the cellular elements and beginning organization of the exudate. 240 diameters (Day 10)

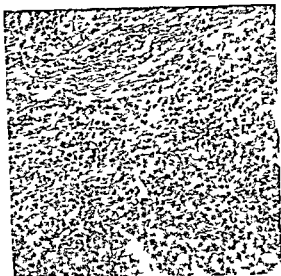


Fig 19 Photomicrograph of the exudate 250 diameters (Day 14)

of the surrounding viscera with at times cavity formation about the site of the duct stump. In one 10 day specimen a sinus tract with necrotic walls led to the ligated duct. In all these specimens it appeared that the gauze drains either prevented exudate deposit or drained away the exudate about the duct and prevented the adjacent structures from covering the duct stump. In one specimen the area of ligation appeared to be in a small abscess cavity.

#### IMPRESSIONS

From a study of the gross and microscopical evidence of the experiments reported and from a knowledge of the anatomical relations, the following resume may be offered.

The cystic duct receives its major blood supply through small branches of the cystic artery. When the cystic artery is ligated well proximal to the point of duct ligation that portion of the duct which is distal to the ligature is deprived of its blood supply while that portion which is proximal to the ligature has a variable amount of decreased blood supply depending upon the amount of duct which is dissected free from the surrounding tissue, the location of the ligation of the cystic artery, and the size and number of the arteries which may lie in the wall of the cystic duct.



Fig 20 Low power photomicrograph showing the cyst in the duct distal to the ligature (Day 20)

Immediately after cholecystectomy the duct stump is covered by an exudate consisting of serum, red blood cells, and leucocytes. In a considerable number of cases red blood cells overshadow the other elements. Adjacent liver lobes cover over the stump and the exudate and the stump of the duct undergoes aseptic necrosis with leucocytic infiltration and partial absorption. The extent of the necrosis depends upon the blood supply. It has been shown that the process extends well proximal to the ligature, and I am inclined to believe that the distance is controlled entirely by the extent of free dissection of the cystic duct, this factor determining the nutrition of the duct. The more duct which is dissected free proximal to the ligature the farther proximal the necrosis extends.

In a few days young connective tissue cells begin to make their appearance in the exudate.

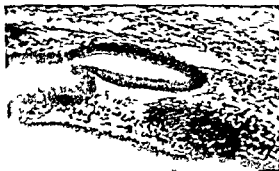


Fig 21 Photomicrograph demonstrating epithelium lining a portion of the inner wall of the cyst 200 diameters (Day 20)

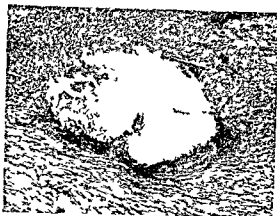


Fig. 22 Low power photomicrograph showing ligature buried in the organizing exudate (Day 27)



Fig. 23 Photomicrograph demonstrating the organizing exudate 1.5 diameters (Day 2)

These cells grow from the viable structures adjacent to the exudate and in this manner the exudate becomes organized and vascularized. The duct stump which has been shown to be undergoing necrosis and absorption may receive a variable amount of nourishment from the surrounding exudate and viable structures but as a rule it is invaded by leucocytes and has a tendency to become sclerotic and absorbed and finally to appear as a mass of scar tissue imbedded in the organized exudate and adjacent infiltrated and sclerotic tissue. Certain cells may remain viable and may eventually become nourished, and young cells may form to the extent of vitalizing portions of the duct stump as evidenced by specimen No. 80 containing the cyst (Figs. 20 and 21).

From our studies it would appear that the cellular proliferation in the duct proximal to the ligature is usually considerably delayed if at all present and is not the essential factor in the duct repair or obliteration but that the organization of the exudate about the duct is the all important process. Any procedure or process which prevents or disturbs this exudate interferes with the prompt, certain, and secure closure of the duct. Our studies upon drained preparations verify this conclusion.

The cells of that portion of the duct wall which is within the grasp of the ligature become atrophic, the cell structure becoming obscure, leaving only collagenous material as

a frame work. These collagen fibers, as a rule have enough tensile strength to hold the duct in position and prevent egress of bile under ordinary pressure. That conditions may obtain which cause the duct to rupture at the site of ligation is evidenced in animal No. 47 which died about 60 hours after operation. At autopsy the belly was found filled with a bile stained fluid and the duct was open at the site of the ligation. Moreover, in animal No. 72 the duct ruptured at the point of ligation with a pressure of 66 millimeters of mercury which is the equivalent of 850 millimeters of water. It has been shown that in man the sphincter of Oddi will withstand a pressure of 500 millimeters of water and that in the animal during vomiting the pressure is often very suddenly raised to 1,000 millimeters of water pressure. It may be surmised therefore that conditions may arise which will cause a rupture of the duct at the site of ligation.

From our observations on the friability of the duct at the point of ligation on the fourth to the sixth days it would seem that but little trauma is necessary to bring about a break in its continuity and that the repair within the duct at this time is by no means sufficient to seal off the lumen so as to prevent bile leakage. Vomiting, coughing or sudden movements may be sufficient to supply this. The constant movement of the liver due to the respiratory excursion may also be a factor. Whether the



Fig 24 Low power photomicrograph showing the ligature buried in fairly well organized tissue (Day 33)

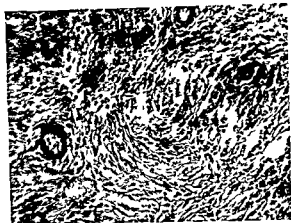


Fig 25 Photomicrograph demonstrating the well organized character of the exudate. This shows several well formed blood vessels 175 diameters (Day 33)

bile has an inhibitory action so far as duct repair is concerned is a question well deserving study for it has been shown that bile is toxic to body tissues and it is reasonable to assume that in the presence of decreased blood supply of the duct wall the bile may exert a destructive influence.

When this evidence is viewed in the light of human anatomy and physiology certain factors and conditions must be taken into consideration. Anatomical differences have been alluded to. In the human when the cystic duct is isolated during a cholecystectomy it is often deprived of all its peritoneal coat and surrounding cellular tissue. There seems little question but that the serous coat is a most essential structure in the repair of all abdominal viscera. When the duct is freely separated the only blood supply remaining is that within the duct wall. Since the necrosis depends upon altered blood supply the more of the duct which is dissected free proximal to the site of ligation the more proximal the necrosis will extend. Moreover, in the human there is less tendency for the liver to cover the stump of the duct although the structures of the duodenohepatic ligament may do so. This structure may and no doubt does function in this respect as does the liver in the dog.

Any inflammatory process of an acute nature may cause liquefaction of the exudate and thus interfere with the normal process of organization. As has been stated before there seems little question but that drainage material which leads to the duct stump is undesirable because of the interference with the formation and deposition of the exudate. It is problematic as to how much exudate will form 72 hours after the gall bladder has been removed, moreover, if a drain is removed at this time it is possible for the trauma to rupture the duct which is unprotected by a sleeve of exudate which normally at this time should be fairly secure. If a drain is employed it should be placed well away from the duct stump so that it can in no way interfere with the formation of the exudate or with the collapse of the surrounding structures over the duct stump.

#### SUGGESTIONS AND CONCLUSIONS

The cystic duct stump after a cholecystectomy occludes itself by a process of organization of the surrounding exudate which is covered with and protected by adjacent living structures.

If the major bile ducts have not been injured at the time of operation or if accessory ducts have not been left open, copious bile leakage after cholecystectomy is due to rupture of the cystic duct at the site of ligation.



Since the cystic duct stump undergoes aseptic necrosis due to deprivation of its blood supply, care should be exercised in its dissection and only a sufficient portion of the duct should be separated to ascertain its identity and the ligature should be placed at the point of contact with undisturbed proximal tissues. A single ligature, not too tightly tied is sufficient to prevent leakage. Multiple ligatures are contra indicated and transfixion will not add to the security of the closure.

In anticipation of bile leakage, drainage should be used only when the duct wall is very friable or extensively changed by a pathological process and should be so placed that it will not interfere with the formation

and deposition of the exudate about the duct or prevent the collapse of the surrounding tissues upon the duct. I am inclined to believe that only rarely is drainage required.

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BILE IN INTESTINAL OBSTRUCTION—EXPERIMENTAL OBSERVATIONS<sup>1</sup>

MAURICE P MEYERS M D DETROIT MICHIGAN AND MILLARD S ROSENBLATT M D PORTLAND OREGON

MUCH experimental work has been done on intestinal obstruction. We have attempted to determine what rôle bile plays in cases of obstruction. Before discussing our experiments, it seems advisable to recount some of the previous findings.

Haden and Orr called attention to the loss of chlorides and the rise in non protein nitrogen of the blood in cases of intestinal obstruction. Foster and Hausler, however, did not believe that hypochloræmia was present in uncomplicated cases and felt that no toxæmia was present, but rather dehydration and starvation. They maintain that there are two types of obstruction: (1) acute simple obstruction and (2) acute strangulation. Gatch, Trusler, and Ayers have the same general classification and feel that in (1) death is due to dehydration and reduction of chlorides, but in (2) toxæmia is present.

Considering the toxic element, there is much in the literature. It has been considered to have its origin in protein decomposition in the bowel, and the intervention of bacteria thought to be necessary in the production of the toxic substance. Stone, Bernheim, and Whipple have thought that the mucosa and not the bowel content furnished the absorbed toxin. Wagensteen and Chun have concluded that all intestinal contents are toxic on injection, even without the presence of obstruction. Both McClure and Gerard have brought out the importance of bacteria in the obstructed loop as a producer of the toxic factor. Murphy and Brooks recognize this toxic substance but feel that it is not absorbed through normal mucosa.

Sweet, Peet, and Hendrix attributed the toxæmia to the action of the pancreatic enzyme on the proteins present in the duodenum. Previous ligation of the pancreatic ducts prolonged life in the obstructed animals. Dragstedt et al. have called attention to the condition of the intestinal wall leading to the obstruction. Gatch, Trusler, and Ayers found that, in closed loops of the jejunum and ileum,

death was always preceded by gangrenous changes in the loop. They concluded that the toxic elements are caused by the bacterial action on the obstructed loop and are not absorbed by normal mucous membrane, but only after tissue necrosis occurs.

In our own experiments it would seem, however, that there is an added factor not yet brought out in cases of simple obstruction. Whether toxæmia is present or not, it would appear that supplying bile to the intestine below obstructions of the small intestine improves the animal's clinical condition and prolongs life. Eisberg produced obstruction in dogs just below the bile ducts and at the pylorus and found the latter to live considerably longer. Brockman feels that bile may be needed in contact with the intestinal mucosa. He also feels that cases of paralytic ileus, clinically, were greatly benefited by rectal injections of bile.

It was Hartwell and Hoguet who first called attention to the value of sodium chloride in prolonging life in cases of obstruction. Foster and Hausler, and also Wagensteen and Chun, have shown that if saline is administered for a few days after obstruction, it may be discontinued with the same prolongation of life as though it were continued. They both feel that sodium chloride is not detoxifying, but they look upon it as do Haden and Orr, McCallum et al. and Gamble and Ross as fulfilling a replacement function.

In our own experiments, twenty three dogs were used. There were several complications of operation, such as peritonitis or pancreatitis which necessitated the discarding of several protocols from our results. Different level obstructions were done and different follow up care was given. The length of life was taken as the titration point of the experiment.

The type of obstruction we produced was of the simple type (proved at autopsy), the lumen was cut across and the proximal end closed, the distal end in most cases was used

<sup>1</sup>A preliminary report. From the B-1 Laboratory of Harper Hospital, Detroit.

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quick change for the better in obstructed animals. They appeared brighter and were able to walk back to their stalls, whereas it had been necessary to carry them to the board where the bile was given. As has been mentioned, on the average they lived twice as long as those who did not get the bile. In some of the cases an animal which had been getting the bile was allowed to go for a period of 24 or 36 hours without it and then, on injecting it, the most marked effects for the better were noted.

We do not attempt to detract from the great place that sodium chloride has won in these conditions. We realize that its protective mechanism is very great, but we do feel that bile is also of the same nature. We think, as do others, that the action of sodium chloride may be that of substitution for depleted chlorides rather than an action of detoxification.

The exclusion of bile from a reasonably large segment of intestine may deprive the body of factors that are badly needed under these circumstances. This may be a deprivation phenomenon, or the bile may have a detoxifying action. The cycle of bile salts, in which they are excreted in the liver and reabsorbed by the intestine, is broken up by the intestinal obstruction since the bile salts are lost by vomiting. This therefore may be a causative factor in the toxemia. This also may explain the quicker fatality of the higher obstructions as well as the great difference in the picture of complete pyloric obstruction from that of a high intestinal one.

#### CONCLUSIONS

1. In a limited number of experiments, it appeared that the presence of human bile in the intestinal tract of dogs with intestinal obstruction caused the obstructed dogs to live longer than those who were not so treated. These animals seemed clinically better after such treatment.

2. We may consider this action as one of substitution of missing factors, as is the action of sodium chloride, or we may consider it as a detoxifying factor.

3. Further investigation is necessary and is being carried on.

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TABLE I—TYPE OF OBSTRUCTION

	Duodenal	Jejunal (high)	Pyloric	Sigmoid
Experiments performed	10	9	3	1
Controls	3	2		1
Human bile	3	5		
Solution of desiccated ox bile	3	1		
Complications	1	2	3	

TABLE II—DURATION OF LIFE

Site of obstruction	Duration of life Controls		Duration of life Human bile given	
	Days	Average	Days	Average
Duodenal	4 3½ 1½	3 days	5½ 8 7½	7 days
High jejunal	3½ 2½	3 days	14 6½ 4½ 4½	7 days (plus)*
Sigmoid	5½	5½ days		

\*There was also a dog which lived 21½ days treated with bile and saline by enterostomy (11 d day) and by hypodermoclysis (starting on the tenth day) which was therefore not included.

†Eviscerated on the 4th day although previously in good condition.

TABLE III—DOG 126, DUODENAL OBSTRUCTION CONTROL WATER GIVEN THROUGH ENTEROSTOMY

Day	Water (oz)	Human bile	Blood on protein nitrogen	Blood chlorides	Condition
Day of operation					
First	8	0	33.4	300	Fair to good
Second	8	0	54.5	200	Good
Third	8	0	43	200	Fair
Fourth	10	0	112.5	180	Fair to poor
			147.2	100	death

to make an enterostomy. In some cases human bile, obtained from operative cholecystostomy drainage cases was given into the enterostomy. In others, ox bile solution made from desiccated ox bile, was used. In still others, saline was given into the enterostomy in amounts equivalent to those of bile. In some cases nothing was given. In one case saline was given subcutaneously to a dog who had been getting bile. The tables may be seen for examples of individual experiments.

On the average, the dogs given bile into the intestinal tract lived twice as long as the dogs with the same type of obstruction who did not receive bile. We found, as have others, that in general the non protein nitrogen tended to in-

TABLE IV—DOG 127, DUODENAL OBSTRUCTION HUMAN BILE GIVEN THROUGH ENTEROSTOMY

Day	Human bile (oz)	Blood non protein nitrogen	Blood chlorides	Blood coagulability	Condition
Day of operation					
First	10	60	325		Good
Second	10	94.5	233	69	Fair
Third	7	129	183		Fair to good
Fourth	10		162		Fair
Fifth	10	129			Fair to poor
Sixth	10	150	166		Fair to poor
Seventh					Death
Eighth					

TABLE V—DOG 114, HIGH JEJUNAL OBSTRUCTION CONTROL SALINE GIVEN THROUGH ENTEROSTOMY

Day	Saline ounces	Human bile	Blood non protein nitrogen	Blood chlorides	Condition
First	8	0	27.3	300	Good
Second	8	0	30	314	Good
Third	8	0	23		Good
Fourth		0			Death

TABLE VI—DOG 122 HIGH JEJUNAL OBSTRUCTION HUMAN BILE GIVEN THROUGH ENTEROSTOMY

Day	Human bile (oz)	Blood non protein nitrogen	Blood chlorides	Condition
First	10	33.4	200	Good
Second	10	40	243	Good
Third	10	40	275	Good
Fourth	10	35.3	260	Good
Fifth	10	54.5	250	Fair to Good
Sixth	10		147	Fair
Seventh	10			Fair
Eighth	10	37.3		Fair
Ninth	10	33	133	Fair
Tenth	10	62.5		Fair
Eleventh	10	43	270	Fair
Twelfth	10	61	144	Fair
Thirteenth	10	129	66.6	Fair
Fourteenth	10			Death

crease and the chlorides to decrease after obstruction.

The solution of desiccated ox bile as used by us was harmful rather than beneficial in prolonging life and caused a diarrhoea of the segment below the obstruction and an appreciable clinical change for the worse. On the other hand, human bile seemed to cause a very

## PREVESICAL, PRIVESICAL AND PERIPROSTATIC SUPPURATIONS

## REVIEW OF LITERATURE AND REPORT OF CASES

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CAREFUL scrutiny of the literature of the past 25 years reveals a decided paucity of recorded observations of local complications following the various operations on the bladder, prostate and urethra. This is surprising in view of the vast number of operations that have been performed on these organs for various reasons during this period. Fortunately, the perfection of technique for all such work has been stressed so long that the occurrence of these disagreeable complications has been rare. This is perhaps due to the fact that the genito-urinary surgeon of today takes the necessary precautions to prevent the appearance of such complications and is on guard to institute immediate and energetic treatment to eradicate them at the earliest moment. These local accidents can occur after cystotomies, cystostomies, cystectomies, and prostatectomies and are always serious and often terminate fatally.

To the French writers is due the credit for bringing the subject to the attention of the genito-urinary surgeon. They have written extensively on the subject not only from the clinical but also from the anatomical and experimental standpoints. They stress particularly the relation of pelvic suppuration to prostatic abscess. Among the contributors to the various phases of the subject it is necessary to cite among others Denonvilliers, Charpy, Veleau, Civiale, Phillips, Faucon, Reliquet, Demarquay, Segond, Proust, Camperon, Desnos, Albarrans, Guyon, Minet, Verseny, Legueu. The American writings on this subject have dealt chiefly with localized periprostatic suppurations following abscess of the prostate. However, within recent years a greater interest has been shown by American workers and important contributions to the anatomical and pathological aspect of this subject have been made by Young, Caulk, Chute, Wesson, Herman, Morrissey, Greenberg, Culver and Baker, and others.

This paper is particularly concerned with the development of postoperative infections in the various spaces about the bladder and prostate following suprapubic and perineal prostatectomy or following any of the preliminary procedures prior to prostatectomy.

## ANATOMY AND TOPOGRAPHY

From a clinical and surgical point of view it is important to recognize the origin, path way of infection, and localization of suppurative conditions which occur in and about the prostate either before or after operation.

A knowledge of the aponeuroses which surround the prostate and the spaces enclosed within these aponeuroses is very essential, because of the role these structures play in the development and localization of collections of pus about the prostate. Consequently, a brief description of the anatomy and topography of these structures is in order.

*The pelvic fascia* (Figs. 1 and 3). The brilliant studies of Wesson have aided greatly in presenting a clear conception of the pelvic fascia. It is made up of a parietal and a visceral layer. The parietal portion is continuous with the psoas and iliac fascia and is attached to the promontory of the sacrum and the iliopectineal line. It then passes down over the posterior pelvic walls to cover the pyriformes muscles and the sacral and pudendal plexuses of nerves. As it passes over the lateral pelvic walls it covers the obturator internus muscles, and at the level of the line extending from the lower part of the symphysis pubis to the spine of the ischium (the so called white line of the pelvic fascia), it divides into two layers. The more external of these two layers is called the obturator fascia and passes downward over the inner surface of the obturator internus muscle to form the outer wall of the ischiorectal fossa. The inner wall of this fossa is lined with the ischiorectal fascia, which is a part of the parietal layer of

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apex where the urethra pierces the gland. This fibromuscular capsule is continuous on its internal aspect with the fibromuscular stroma of the gland and on its external aspect with the fibromuscular tissues that unite the prostatic capsule with the periprostatic sheaths or aponeuroses and the cellular spaces. The firmness and integrity of this capsule serves a useful purpose in limiting the extension of a suppurative process within the gland and accounts for the tendency of introprostatic suppurations to rupture internally into the urethra instead of into the loose periprostatic tissue.

The prostate is closely surrounded on all sides by fascial sheaths (Fig. 2) or aponeuroses except at its upper and lower portions where the prostate fuses with the bladder and the membranous urethra respectively. The aponeuroses have been properly classified by Aversenq from their anatomical relation to the prostate: (1) anterior periprostatic aponeurosis or fascia, (2) lateral periprostatic aponeurosis or fascia, (3) posterior periprostatic aponeurosis or fascia, and (4) median aponeurosis (part of triangular ligament).

*The anterior periprostatic fascia* (Figs. 2 and 3). The anterior periprostatic fascia is also known as the puboprostatic fascia of Denonvillier or fascia of Zuckerkandl or the fibrous preprostatic fascia of Delbet. It extends from the anterior surface of the bladder to the posterior surface of the pubis at its lower border. It lies a few millimeters in front of the prostate and covers the venous plexus of Santorini. Laterally this sheath blends with the aponeuroses of the levator ani and posteriorly it fuses with the prevesical fascia of Charpy. The lowest portion of this sheath is separated from the prostate by the stratified muscle fibers of the external sphincter and the posterior urethra in the region of the apex of the prostate. The actual width of the anterior periprostatic fascia is scarcely more than 1 centimeter and it occupies the space between the anterior ligaments of the bladder which extends from the bladder to the posterior surface of the pubis and to the prostate. The anterior periprostatic fascia appears to be a thin layer of fibrous tissue

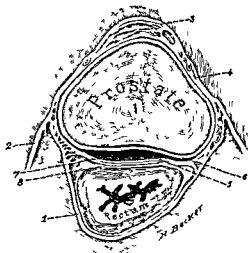


Fig. 2. Transverse section through the midportion of the prostate to show the relation of the periprostatic fascias (after Aversenq and Dieulafoy). 1, fascia recti; 2, fascia of the levator ani (endopelvic fascia); 3, anterior periprostatic fascia; 4, lateral periprostatic fascia; 5, posterior periprostatic fascia—2 layers (fascia of Denonvilliers); 6, capsule of the prostate; 7, posterior periprostatic space (or retroprostatic separable space); and 8, prerectal fascia.

but is quite resistant as evidenced by the rarity of extension of inflammations beyond it during and after perineal operations. The dorsal veins of the penis pierce it to reach the venous plexus at the base of the bladder.

*The lateral periprostatic fascia* (Fig. 2). The lateral periprostatic fascia is also known as the puborectal fascia of Denonvilliers. This fascia is rather intimately united to the prostate by loose connective tissue through which run the veins found on the lateral aspect of the gland. The lateral periprostatic fascia is essentially an extension of the fascia of the levator ani. It is composed of a horizontal and a vertical portion, continuous with one another. The horizontal portion at its inferior aspect blends with the superficial layer of the triangular ligament and at its superior aspect is continuous with the inferior border of the levator ani muscle. At the posterolateral angle of the prostate the deep layers of the lateral periprostatic fascia fuse with the fibrous elongations from the posterior periprostatic and prerectal fascias and continue on anteriorly to the region of the bladder.

The vertical portion is almost quadrilateral in shape and extends from the side of the



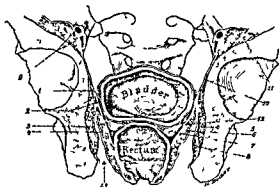


FIG 1 Vertical section through the pelvis showing relation of fascial layers to pelvic wall and floor (after Deaver's *Surgical Anatomy*) 1, White line 2, rectovesical fascia (superior fascia of pelvic diaphragm) 3, obturator fascia 4, ischiorectal or anal fascia (inferior fascia of pelvic diaphragm) 5, obturator internus muscle 6, levator ani muscle 7, seminal vesicles and vas deferens 8, internal pudendal vessels in Alcock's canal 9, external iliac vessels, 10, pelvic fascia, 11, iliac fascia, 12, endopelvic fascia 13, ischiorectal fossa.

the pelvic fascia. This external layer (obturator fascia) is continuous across the anterior part of the pelvic outlet with the corresponding fascia of the opposite side and thus forms the deep layer of the triangular ligament.

The inner layer is known as the visceral layer and is sometimes described as the rectovesical fascia but is essentially a continuation of the pelvic fascia. The visceral layer serves as a membranous diaphragm separating the pelvic cavity above from the perineum below. The visceral layer passes downward and inward upon the upper (or pelvic) surface of the levator ani muscles and then passes over the surface of the prostate gland, seminal vesicles, bladder, and rectum. This fibrous covering is often termed the endopelvic fascia.

The term "rectovesical fascia" has been restricted within recent years to that portion of the fascia which lies between the rectum and bladder and which encloses the seminal vesicles. This layer is of utmost importance in connection with the direction and course of suppurative lesions following operations upon the bladder and prostate.

The visceral layer of the pelvic fascia is made up of numerous fascial planes or bands which divide the pelvis into separate compartments and as such will be described later under the heading of anterior, lateral and

posterior periprostatic fascias. In the posterior part of the pelvis, the visceral layer of the pelvic fascia is pierced by the rectum and is reflected upon the rectum as the rectal or prerectal fascia.

As the visceral fascia passes inward from the white line on either side, it passes upon the posterior surface of the bladder and turns upward upon the base and sides of the bladder to form the lateral true ligaments of the bladder. When the fascia reaches the junction of the prostate and bladder, it splits into two layers, one passing up over the bladder as the vesical fascia, which contributes to the fibrous coats of that organ and the other passes downward upon the prostate enveloping that organ in a loose sheath the constituent parts of which are known as anterior, lateral, and posterior periprostatic fascias (Fig 2). The portion of the visceral layer enveloping the prostate becomes continuous at the apex of the prostate with the deep layer of the triangular ligament (a part of the parietal pelvic fascia) and is continued forward in the form of two bands known as the anterior true ligaments of the bladder.

The portion of the visceral layer covering the bladder splits on either side of the midline to enclose each seminal vesicle and vas deferens and also gives rise to a layer of fascia that forms the outer coat of the ejaculatory duct as it passes through the prostate.

The prostate gland snugly encircles the posterior urethra and the vesical neck, and the intimate relation of these structures serves to explain why the posterior urethra and bladder are so frequently the origin of suppurative lesions of the prostate. The prostate is composed of large tubular glands situated in the deepest portion of the gland and connected to the posterior urethra by long ducts. The stroma of the gland is made up of fibrous connective tissue and smooth muscle fibers. It is by the contraction of these muscle fibers that the secretions are expressed from the acini through the ducts into the posterior urethra during the normal physiological activity of this gland.

The true capsule of the prostate is a well-defined fibromuscular membrane which surrounds the entire gland except at its base and

apex where the urethra pierces the gland. This fibromuscular capsule is continuous on its internal aspect with the fibromuscular stroma of the gland and on its external aspect with the fibromuscular tissues that unite the prostatic capsule with the periprostatic sheaths or aponeuroses and the cellular spaces. The firmness and integrity of this capsule serves a useful purpose in limiting the extension of a suppurative process within the gland and accounts for the tendency of intro prostatic suppurations to rupture internally into the urethra instead of into the loose periprostatic tissue.

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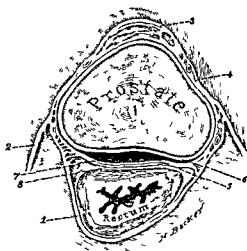


Fig. 2. Transverse section through the midportion of the prostate to show the relation of the periprostatic fascias (after Averseny and Dieulafoy). 1 Fascia recti, 2 fascia of the levator ani (endopelvic fascia), 3 anterior periprostatic fascia, 4 lateral periprostatic fascia, 5 posterior periprostatic fascia—2 layers (fascia of Denonvillier), 6 capsule of the prostate, 7 posterior periprostatic space (or retroprostatic separable space) and 8, prerectal fascia.

but is quite resistant as evidenced by the rarity of extension of inflammations beyond it during and after perineal operations. The dorsal veins of the penis pierce it to reach the venous plexus at the base of the bladder.

*The lateral periprostatic fascia* (Fig. 2). The lateral periprostatic fascia is also known as the puborectal fascia of Denonvillier. This fascia is rather intimately united to the prostate by loose connective tissue through which run the veins found on the lateral aspect of the gland. The lateral periprostatic fascia is essentially an extension of the fascia of the levator ani. It is composed of a horizontal and a vertical portion, continuous with one another. The horizontal portion at its inferior aspect blends with the superficial layer of the triangular ligament and at its superior aspect is continuous with the inferior border of the levator ani muscle. At the posterolateral angle of the prostate the deep layers of the lateral periprostatic fascia fuse with the fibrous elongations from the posterior periprostatic and prerectal fascias and continue on anteriorly to the region of the bladder.

The vertical portion is almost quadrilateral in shape and extends from the side of the

symphysis pubis to the region of the rectum and levator ani. It extends from anterior perineal fascia (combined anterior ligaments of the bladder and the anterior periprostatic fascia) down to the deep layer of the triangular ligament. On its external surface it is intimately adherent to the levator ani and on its internal surface is separated from the membranous urethra by striated muscle fibers of the external sphincter.

*The posterior periprostatic fascia* (Figs 2 and 3). Originally the posterior periprostatic fascia was described as the prostatoperitoneal fascia of Denonvilliers and now is commonly known as the fascia of Denonvilliers. This fascia covers the posterior surface of the prostate, seminal vesicles, and bladder. At its posterior border it fuses with the subperitoneal tissue of the rectovesical cul de sac, and at its anterior border it is inserted on the muscular sheath of the membranous urethra just below the apex of the prostate. Laterally this fascia blends with fascial elongations from the levator ani and fascia recti, the union taking place at the postero-lateral angle of the prostate just below the vein which is commonly found in this position. In the region of the seminal vesicles, the fascia of Denonvilliers is firmly adherent, due to the numerous fibrous adhesions between these structures.

The fascia of Denonvilliers is a firm, dense sheath composed of fibrous and elastic connective tissue. The elastic fibers impart the characteristic shiny appearance of this fascia. This fascia is most marked and thickest in the midline and may contain muscle fibers in its lateral aspects especially in well developed individuals. The fascia is composed of two layers, an anterior layer and a posterior layer. The anterior layer covers the prostate, the posterior layer covers the rectum. Between those two layers is a potential space. The anterior layer is thicker and more resistant than the posterior layer. The ejaculatory ducts receive an investment from this fascia as they traverse the prostate. It was formerly believed that the fascia of Denonvilliers was formed by a fusion of the two layers of fetal peritoneum (Cunéo and Veau). However, Wesson has shown in his

classical studies that this fascia is formed by a condensation of mesenchymal tissue occurring subsequent to the formation of the urethra.

*The median fascia*. This fascia represents the inferior layer of the triangular ligament. The triangular ligament is also described as the ligament of Carcassone, the median perineal fascia of Blandin, the anopubic fascia of Velpeau, but more commonly known as the triangular ligament of Colles. It is composed of two layers of fibrous tissue which occupy the interpubic arch. The inferior layer (or median fascia) is the strongest and most resistant of the two. The superior layer is only a cellular sheath covering the transverse perineal muscles. Between the two layers are found muscular fibers running in different directions which have their origin in the anal sphincter or transverse perineal muscles, and are prolonged on to the bulb as the recto-urethralis muscle fibers. The internal pudendal artery, the two veins to the bulb with its smaller branches, and the two glands of Cowper first traverse the space between the two layers of the triangular ligament and then pierce the ligament itself.

These fascial sheaths on the superior, inferior, and lateral aspects of the prostate gland inclose a potential quadrangular space about the prostate recognized by the French writers as *la loge prostatique*. These intra-fascial spaces are in front, the anterior periprostatic space, on the sides the lateral periprostatic space, and behind the posterior periprostatic space. The extra-aponeurotic spaces are situated behind the periprostatic aponeuroses and consequently are found behind the aforementioned spaces, these are, in front, the anterior extraprostatic space or space of Retzius laterally the superior pelvic space and behind, the posterior extraprostatic space or prerectal space.

*Anterior prerectal space* (Fig 3). This area is commonly called the space of Retzius and is the most frequent site of localized postoperative infections. The space of Retzius is one of three spaces found anterior to the bladder resulting from the division of the transversalis fascia. The fascia covering the posterior surface of the upper portion of

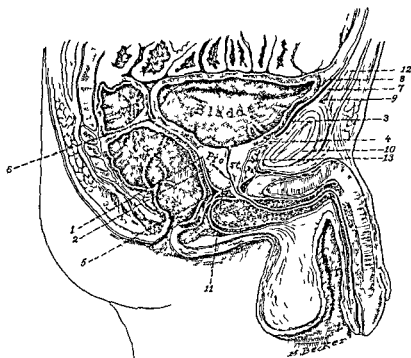


Fig 3 Drawing to show the various fascias concerned in the formation of the potential separable spaces about the bladder and prostate (after Deaver's *Surgical Anatomy*) 1 Capsule of prostate and posterior bladder wall 2 posterior periprostatic (Denonvilliers) fascia 3 prevesical space (space of Retzius) 4 anterior (pubo-prostatic) ligament of bladder 5 retrovesical separable space 6 rectovesical peritoneal fold 7 anterior layer of transversalis fascia 8 posterior layer of transversalis fascia 9 retromuscular space 10 pubic bone 11 triangular ligament 12 rectus muscle and 13 anterior periprostatic fascia

the recti muscles ends just below the umbilicus at the semilunar fold of Douglas, extending downward from this point are two thin layers of transversalis fascia. The anterior layer covers the posterior surface of the lower portion of the recti muscles and is attached to the superior border of the symphysis pubis. The posterior layer passes down over the bladder to fuse with the visceral layer of the pelvic fascia. Between the anterior layer of the transversalis fascia and the posterior surface of the lower portion of the recti muscles is the so called retromuscular space (Fig 3).

The prevesical space of Retzius is bounded anteriorly by the symphysis pubis and the anterior layer of the transversalis fascia, posteriorly, by the posterior layer of the same fascia, superiorly, by the fusion of the two layers of transversalis fascia at the semi-

lunar fold of Douglas, inferiorly by the anterior periprostatic fascia, and laterally by the fusion of the two layers of the transversalis fascia with the aponeuroses of the transversalis and oblique muscles.

The third space situated anterior to the bladder is called by Aversenq the anterior perivesical space which is essentially a continuation of the anterior periprostatic space. The boundaries of this space are anteriorly, the prevesico-pelvic sheath (posterior layer of transversalis fascia) which fuses with the anterior periprostatic fascia behind, the symphysis pubis, superiorly the peritoneum, and posteriorly, the bladder musculature.

The recto urethralis muscle is essentially a group of smooth muscle fibers having its origin in the anterior, thickened longitudinal band of the rectum at the level of the verumontanum. It passes forward over the

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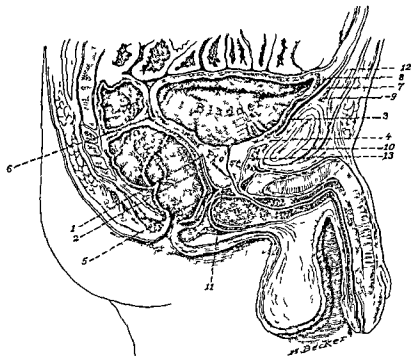


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posterior surface of the prostate to fuse with the raphe of the external vesical sphincter.

The levator ani muscles (Figs 1 and 4) are lateral to the prostate and distinctly separated from it. The levator ani does not contribute any fibers to the recto urethralis muscle. Morrison describes the origin of this muscle: this muscle has an extensive origin, in the front, from the posterior surface of the pubis near the symphysis, behind, from the spine of the ischium, and between those points from the pelvic fascia along the line of attachment of the obturator fascia. From these points the muscle fibers pass downward and inward toward the middle line of the floor of the pelvis. Some of the fibers of this muscle fuse with the external vesical sphincter and the deep transverse perineal muscles. The levator ani of either side gives off fibers which, after passing around the prostate and urethra, descend between the rectum and genito urinary passage.

#### ETIOLOGY

The mechanism of the development of inflammatory lesions about the prostate and bladder following any operative procedure on these organs and their associated structures, has been the subject of much controversy, and considerable speculation. The work of Legueu, Delbet, Averseng and their associates has aided greatly in the understanding of postoperative periprostatic inflammations. A study of perivesical and periprostatic infections entails a consideration of (1) causative agents, (2) pathway of infections, and (3) localization of inflammatory collections.

#### CAUSATIVE AGENTS

The etiological factors in the development of such lesions are manifold. A correct classification must necessarily include those factors of urinary and nonurinary origin but for all practical purposes may be considered under two groups. (A) exacerbation after operation of some old pre-existing lesion of the bladder, prostate, seminal vesicles or urethra. (B) introduction of some infecting agent at the time of operation or during the postoperative course.

The influence of acute bladder infections upon the development of perivesical suppurations remains a debatable question and is particularly related to the occurrence of suppurative pericystitis in nonoperative cases following stricture or rupture of the posterior urethra, a subject with which this paper is not particularly concerned. However Halle and Motz have shown that the infectious process in an acute bladder infection never extends into the bladder musculature or perivesical tissues by direct extension or through the lymph stream. The inference drawn from their work is that the infectious agent can reach the pericystic tissues only by taking a very circuitous route through the blood stream. Many of the recent writers disagree with this view, contending that intravesical infections do play an important role in the production of perivesical suppurations.

The most frequent cause of a pericystitis is chronic cystitis. It is well known that chronic cystitis is usually accompanied by a varying degree of perivesical infiltration of a chronic fibrolipomatous nature often known as chronic sclerosing pericystitis. It is possible for an acute suppuration of the loose perivesical tissues to occur during the course of a chronic cystitis. Most of the prostatic patients have some degree of residual urine with its accompanying stagnation and infection resulting in a chronic cystitis. This type of lesion is often dormant and devoid of outward manifestations but following instrumentation may flare up and lead to serious consequences. Such an infection might serve as a persistent focus of infection despite preoperative attempts to clear it up by internal medication, lavage, retention catheter, or preliminary suprapubic drainage.

In some of the old infected prostatic cases there may exist small intramural abscesses in various parts of the bladder. The inflammatory process may be the result of the infection and suppuration of the small 'inter rupting nodules' of lymphoid tissue found on both surfaces of the bladder. Very often the intramural abscesses are found in that portion of the bladder lying over the seminal vesicles and are due perhaps to an extension

of an inflammation from the latter structures. These abscesses may be present for a long time without giving rise to symptoms. Their existence in various stages of infiltration and suppuration often pass unrecognized until detected at the operating table or in the autopsy room. Such abscesses, developing insidiously, may open suddenly into the perivesical tissues at any stage of the post-operative convalescence and set up a severe perivesical cellulitis which is extremely difficult to combat and very often terminates fatally.

Other intravesical conditions, i.e., calculus, foreign body, ulcers, tumors, diverticula, and tuberculosis may be associated with a chronic cystitis and must be considered as possible etiological factors in perivesical suppurations. Tuberculosis of the bladder may be accompanied by a varying degree of pericycstic infiltration which is usually of the sclerotic rather than of the suppurative type although Caulk has noted acute suppurative pericycstitis following spontaneous rupture of a tuberculous bladder. Inflammatory changes in the perivesical tissues may be associated with bladder neoplasms which frequently simulate malignant extension and these changes may occasionally produce suppurative lesions in the pericycstic tissues.

In many cases of prostatic hypertrophy a marked inflammation of the mucosa of the posterior urethra accompanies the chronic cystitis that is usually present. If the patient has been subjected to frequent attacks of retention with repeated catheterization for relief, the local condition may be aggravated and may often lead to the formation of single or multiple ulcers which serve admirably as foci of infection. The repeated instrumentation of these infected cases for relief of the urinary retention or for examination and study is always attended with the danger of causing a false passage or tear in the posterior urethral wall which provides an excellent portal of entry for the pathogenic organisms found in the bladder and urethra of these cases.

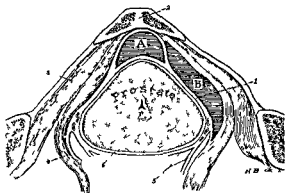


Fig. 4. Abscess in the anterior periprostatic space and in the superior perirectal space (after Aversenq and Dieulafoy). 1 Lateral periprostatic fascia 2 pubic bone 3 obturator internus muscle 4 levator ani muscle 5 posterior periprostatic fascia or fascia of Denonvilliers (2 layers) 6 capsule of prostate gland A abscess in the anterior periprostatic space and B abscess in the superior perirectal space.

orthopnea. During his stay in the hospital he developed a marked frequency, dysuria and burning on urination and voided in very small amounts. Because of large amounts of residual urine caused by an enlarged obstructing prostate a retention catheter was inserted. The bladder was treated with retention catheter for 6 weeks. Cystoscopy was performed at this time by the house surgeon and a marked amount of bleeding occurred. A catheter was reinserted and the patient's temperature rose to 103 degrees. He was very toxic for several days. During the course of his treatment following cystoscopy his urine became infected and thick, pus was discharged through the catheter for over 6 weeks.

Rectal examination at this time revealed an induration along the posterior and lateral aspects of the prostate and extending up along the base of the bladder. The patient's condition gradually became worse and it was deemed advisable to cystoscope the patient again to locate if possible the origin of the pus. The vesical orifice was very irregular and the prostatic urethra was very markedly injected and appeared to have several lacerations on its posterior surface. Pus could be seen oozing from a pouch in the posterior wall of the prostatic urethra. Catheter was reinserted but removed in 2 days. Patient was treated with hot rectal douches and the condition gradually subsided. He began voiding and continued to do so for 18 days when he was discharged from the hospital with the advice to return for a prostatectomy at a later date. The patient was readmitted to the hospital and a perineal prostatectomy was performed 4 months later. Patient had an uneventful recovery with a perfect functional result.

Case 5644 (Med.) D. K. white male aged 70 years was admitted to the Sinai Hospital on the medical service complaining of marked dyspnea and

This case illustrates the type of infection that may result from instrumentation of the



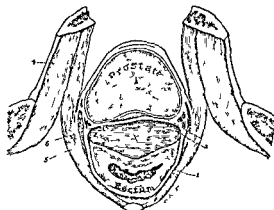


Fig 5 Transverse section of pelvis showing an abscess of the posterior extraprostatic space resulting from the spread of the inflammatory process through the posterior periprostatic fascia (after Aversenq and Dieulafe) 1 Abscess in posterior extraprostatic space 2 fascia recti 3 posterior periprostatic fascia 4 capsule of prostate 5 obturator internus muscle 6 levator ani muscle and 6 posterior periprostatic space (separable space)

posterior urethra or following cystoscopic examinations. Undoubtedly, the source of infection was an infected prostatic urethra and bladder. The avenue of infection was through a tear in the posterior wall of the prostatic urethra. The infectious process must have involved the prostate gland and the posterior periprostatic space or the retroprostatic and retrovesical separable spaces. Fortunately drainage occurred through the opening of the prostatic urethra and with the expectant treatment the condition subsided.

These old infected prostatic patients often have an accompanying seminal vesiculitis or prostatitis which may be aggravated by instrumentation. The extension of the inflammatory lesion of the posterior urethra to the prostate, seminal vesicles, vas deferens, and epididymis is undoubtedly more frequent in the catheterized group of patients than in the noncatheterized group. The opening of the different ducts in the posterior urethra can easily be infected by the passage of an instrument. Not infrequently during the removal of an enlarged prostate by the perineal route, the operator may notice an outflow of purulent fluid about the ejaculatory ducts, of either prostatic or seminal vesical origin.

An abscess of the prostate may exist within the hypertrophied prostate and may remain

unrecognized until the bladder or prostate is opened to remove the suspected enlargement. The prostatic abscess may follow recent instrumentation or may be associated with stricture of the urethra, stone in the urethra or prostate, or an old gonorrheal urethritis. The infection within the prostate may be a limited one as the infecting agent may be overcome at an early stage (catarrhal or parenchymatous involvement of the prostate) and undergo resolution. In some instances the process may continue on to abscess formation. The abscess may rupture spontaneously into the posterior urethra while at stool or following manipulation of the finger in the rectum. Occasionally the abscess may break through the prostatic capsule and invade the periprostatic spaces and set up a periprostatic cellulitis. If the inflammation is confined to the posterior periprostatic space, it may give rise to a firm mass which may be confused with an enlarged prostate.

It must be borne in mind that extravascular lesions may sometimes be the etiological factor in the production of suppuration in the perivesical and periprostatic tissues. Localized perivesical inflammations may be complications of an acute appendicitis or sigmoid diverticulitis when these organs are in close proximity to the bladder. Tuberculosis or carcinoma of the intestines may give rise to a secondary infection of the perivesical tissues. Osteomyelitis and tuberculosis of the pubic bone may occasionally be the causative agents in pericystic infections. Distant foci of infections such as infected teeth, tonsils, respiratory tract lesions, carbuncles, and so on, may be responsible for perivesical infections reaching the latter area by way of the blood stream.

#### TYPES OF INFECTION

The postoperative suppurative lesions about the prostate and bladder vary in severity and chronicity and for all practical purposes may be considered as mild or severe conditions.

The mild type of suppuration occurs within a relatively short time after operation. It is essentially a localized abscess confined to the space of Retzius. This form of infection is

the result of flooding the prevesical space with infective material at the time of operation and of inadequate drainage after operation. These lesions usually respond quickly to treatment in the form of adequate drainage and irrigation of the infected area. These patients all have septic temperatures with localized signs of infection and pain. The pain is usually in the lower abdominal or bladder region. Often the movement of the hip joints increases pain and the patient prefers lying flat on the back with thighs in flexion. Constipation or diarrhoea may be present.

Occasionally if the infection is not recognized early and not treated properly, it may spread to the remaining extrafascial spaces, i.e., the prerectal and superior perirectal spaces and set up a diffuse cellulitis. The inflammation may extend, in front, up to the anterior abdominal wall or to the peritoneum of the iliac fossa or it may involve the pubic bone, laterally it may descend to the ischio-rectal space, behind, to the perineal region below and to the lumbar region above. When the process becomes diffuse the patient usually develops a septicæmia and succumbs.

The severe type of inflammation is of insidious onset occurring at a time when the suprapubic wound is closed or a small clean healing fistula is present. There do not appear to be local signs of infection about the wound yet the patient is toxic having an elevated septic temperature often accompanied by repeated chills. He is easily fatigued. There is a loss of weight and appetite. He appears anxious and later may become prostrate if the sepsis persists.

Pain is a constant symptom in these cases. When the infection is confined to the space of Retzius the patient complains of pain in the suprapubic or bladder region but if the infection spreads down along the sides of the bladder the pain may be referred to the anal or perineal region depending upon the localization of the infection. Occasionally crepitation may be elicited over the suprapubic area of infection.

Bladder symptoms, such as frequency and dysuria, may be present provided the patient has already regained urinary function. Gastro-

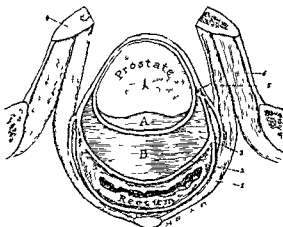


Fig 6 Abscess in posterior periprostatic space and subcapsular abscess (after Averseng and Dieulafoy) 1, Fascia recti 2 posterior periprostatic fascia (or fascia of Denonvilliers) (2 layers) 3 capsule of prostate 4 inferior ramus of pubic bone 5 obturator internus muscle 6 levator ani muscle A subcapsular abscess and B posterior periprostatic abscess

intestinal symptoms are not particularly marked in the early stages of the infections but later in the course, nausea and vomiting may occur. Bowel function may become painful and is accompanied by either diarrhoea or constipation especially if the infection has spread to the retrovesical and retroprostatic planes.

This type of infection usually leads to a septicæmia with a fatal ending. The underlying cause is a hidden abscess developing slowly about the prostate and base of the bladder and often not palpable on rectal examination. After some time the infection may eventually appear around the suprapubic wound but is difficult to diagnose because of the lack of local signs.

The presence of a tumor mass in the suprapubic region which simulates a distended bladder and is fluctuant on palpation and painful on motion of the body is a diagnostic objective sign. The diagnosis may be confirmed by passing a catheter into the bladder and noting that the mass does not subside after all the urine is withdrawn from the bladder. The surgeon should always perform a rectal examination in these cases to detect the presence of a fluctuating and tender mass about the bladder and prostate. The infection may appear at some distant focus,

i e., in the inguinal canal, in the groin, on either side of the perineum, among the muscles of the thigh, or in the pelvis. When the abscess points in any of these superficial places and is incised and drained, instead of complete recovery, there is a temporary alleviation of symptoms with the formation of other new collections at different places. As long as the original focus of infection about the prostatic bed remains unrecognized and untreated, the resistance of the patient is overcome, he develops a septicæmia, and succumbs.

#### THE PATHWAY OF INFECTION

The propagation and extension of localized lesions into the tissues surrounding the operative field has been the subject of considerable controversy and of little investigation. Three possible routes may be considered (1) direct extension by cellular infiltration, (2) lymphatics, (3) blood stream.

*Direct extension.* This route serves to explain a large number of prevesical inflammations occurring within a relatively short time after a suprapubic bladder operation. Such infections are confined to the space of Retzius and are practically always accompanied by a delayed closure of the suprapubic wound and the formation of a persistent suprapubic fistula. This type of infection is due to a flooding of this region with infected urine at the time of operation or inadequate drainage of this area and the bladder after operation.

The relation of drainage to prevesical inflammations is worthy of more than passing comment. The insertions of gauze drains or rubber tubes into the space of Retzius and into the bladder following suprapubic operations tends to prevent accumulations of infective material in the deep pocket created behind the pubic bone. In all such cases drainage takes place in an upward direction and in some instances might prove to be insufficient, with the result that there is a gradual accumulation of infected urine behind the pubic bone. The prolonged stasis of this urine may lead to inflammatory lesions varying from a mild suppuration to extensive abscess formation with necrosis and gangrene of the tissues involved.

Fortunately for the patient most of the infections in this area are recognized early and respond quickly to proper drainage and irrigation. Occasionally the infection is a virulent one and the infiltration progresses rapidly and spreads insidiously into the cellular planes about the base of the bladder. It may pass upward and point under the skin of the inguinal region or pass down to the iliac fossæ. It may attack the posterior surface of the pubic bone setting up a periosteitis and later burrow under the adductor muscles on the inner aspect of the thigh.

There is a very small group of cases in which infection of the periprostatic and perivesical areas occurs at some time after operation. In this type of case, the suprapubic wound heals well but a localized abscess is found at some distant point such as the inguinal or iliac regions or in the abdominal walls. The primary focus of infection is a slow growing abscess of the prostate or bladder wall which opens into the fascial planes around the prostate and base of the bladder during the patient's postoperative convalescence. Such a small abscess is often encountered at operation and heals spontaneously but more frequently remains unrecognized. These small abscesses are found on the sides or the base of the prostate or on the lower portion of the posterior bladder wall and are beyond the reach of the finger in the rectum. Unfortunately, there appears to be no connection between the prostate or bladder and the localized abscess in the abdominal or inguinal regions. Incision and drainage of localized abscess give temporary relief but as the original focus in the prostate and bladder wall remains unsuspected the old abscess persists or new ones develop. The patient gradually succumbs to a long drawn out infection.

*Lymphatic route* (Figs 8 and 9). The rôle of the lymphatics in the propagation of inflammations about the prostate and bladder following operations is most important. The lymphatic drainage of these areas has been rather clearly worked out and demonstrates a closely related distribution and ultimate destination which in all probability determines the direction of these infections.

The lymphatic system of the bulbous and membranous urethra is essentially made up of 3 groups of afferent vessels. One afferent trunk is found on the upper surface of the bulb usually in the angle between the corpora cavernosa and follows the course of the artery of the bulb and later the internal pudic artery to enter the deep layers of the pelvis and drain into the hypogastric glands. A second afferent trunk passes behind the symphysis pubis to drain into the retrocrural gland. A third trunk passes up on the anterior surface of the bladder, unites with the lymphatics draining the inferior portion of the bladder, and enters the middle gland of the internal chain of external iliac glands.

The lymphatics of the prostatic urethra unite with collecting trunks that drain the prostate gland. The lymphatic channels about the posterior urethra and the vesical orifices are especially wide and easily discernible in microscopical sections.

The lymphatics of the prostate are quite numerous. They begin as a fine capillary network surrounding the acini of the gland. From this periacinous network larger vessels pass to the periphery of the gland to form a periprostatic network. It is from this latter network found on each of the four surfaces of the gland that symmetrical collecting trunks arise.

A large trunk from the posterior surface of the gland passes upward on the bladder in the triangle between the two vasa deferentia as far as the middle part of postero superior surface of the bladder. At this level it makes a sharp curve outward, crossing the hypogastric artery to end in the middle gland of the internal chain of the external iliac group. As the lymphatics run along the posterior surface of the bladder they pass through some small interrupting nodules.

Another collecting trunk from the posterior surface of the gland accompanies the internal pudic artery and passes in an upward, outward, and backward direction to terminate in the middle gland of the hypogastric group.

Two or three afferent trunks arise on the posterior and lateral surfaces of the gland and pass downward and backward in the sacro

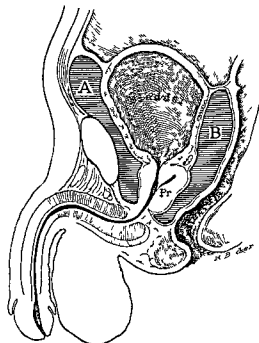


Fig. 7 Drawing representing the two most common sites for the localization of pus about the bladder and prostate (after Culver and Baker). A Abscess in the prevesical space (space of Retzius) and B abscess in the retrovesical separable space (posterior periprostatic space).

genital fold. They cross the lateral surface of the rectum to end in the lateral sacral gland and those glands along the sacrum as high up as the promontory.

Collecting trunks from the anterior surface pass down to the deep pelvic fascia to unite with collecting trunks from the membranous urethra and pass along the course of the internal pudic vessels to terminate in the hypogastric group of lymph glands.

The lymphatics of the bladder are found in the muscularis and in the submucosa. The mucosa of the bladder is entirely devoid of lymphatics. The network found in the muscularis is well developed and gives off branches which pass to the external surface of the bladder and form a second network of lymph vessels. The afferent trunks from the peripheral network take different courses depending upon their situation on the anterior or posterior surface of the bladder.

The anterior surface has two groups of collecting trunks corresponding to the inferior and superior segments of the bladder.

In the inferior group the vessels run in an outward direction to drain into one or more glands of the external iliac group on the lateral surface of the pelvis between the obturator nerve and the external iliac vein.

In the superior group the lymphatic trunks from the upper segment of the bladder take an upward and outward course and after crossing the hypogastric arteries terminate in the middle chain of the external iliac group.

One posterior surface has several groups of collecting trunks. The afferent vessels from the superior portion unite with those of upper segments of the anterior surface and enter the external iliac group. Other collecting trunks from the posterior surface pass in a backward direction to terminate in the external iliac glands situated near bifurcation of the common iliac artery. The afferent lymphatics from the middle portion of the posterior surface end in the hypogastric group. The lymphatics from the inferior segment and vesical neck pass directly backward over the lateral surface of the rectum and then upward over the sacrum to end in the glands as high up as the sacral promontory.

As the afferent lymphatics pass over the anterior and posterior surfaces of the bladder, their course is interrupted by small nodules of lymphoid tissue or secondary glands which are called "*interrupting nodules*" and correspond to *Skaldruesen* of the Germans. These small nodules play an important part in the formation of intramural abscesses as they may easily become inflamed and if suppuration ensues may lead to a perivesical infection.

In the region of the neck of the bladder there is a rich anastomosis of the lymphatics of the vas deferens with those of the prostate, posterior urethra, and bladder. About the base of the bladder, the lymphatics of the bladder become continuous with those of the seminal vesicles and lower part of ureter.

The lymphatics of the seminal vesicles are found in the submucosa and muscularis and drain into the hypogastric lymph nodes.

The ureter has an abundant network of lymphatics in its muscularis and external fibrous sheath. However, the lymphatic

drainage of the ureter varies with the different parts. The efferent trunks of the lower third join with those of the bladder and urethra to drain into the hypogastric nodes. From the middle third of the ureter the efferent lymphatics terminate in the lumbar nodes situated along the vena cava and aorta just above the bifurcation. The lymphatics of the upper third of the ureter join with those of the kidney and enter the group of aortic lymph nodes above and below the level of the renal vessels. The lymphatics of the ureter anastomose with those of the bladder and kidney.

The lymphatics of the kidney are rather abundant and intimately surround the tubules and glomeruli. In addition there is also a subcapsular network. There is an intimate anastomosis between these two groups. The drainage of the kidney is through the lymphatics of the hilum of the kidney into the aortic nodes about the level of the renal vessels and through the lymphatics of the kidney capsule to the lumbar nodes. The lymphatics of the kidney capsule join with those of the fatty capsule.

In brief, then, there is a close relation between the lymphatic supply of the genito urinary system, as evidenced by the intercommunication between the efferent lymphatics of the prostate, seminal vesicles, urethra, and bladder, and that of the ureter, pelvis, and kidneys. There is no anastomosis between the lymphatics of the genito urinary organs and the rectum, as the latter is a part of an extensive lymphatic system of the intestinal tract.

The development of perivesical and prostatic infections after operation in most instances is dependent upon a septic lymphangitis. These infections are prone to occur in old infected prostatic cases in which the prostatic urethra, prostate and bladder walls are the sites of a chronic inflammatory process as the result of long standing retention of urine and repeated instrumentation. This inflammatory process may be superficial or deep and may be associated with small ulcers or abscesses. Although the operation (suprapubic cystotomy or prostatectomy) relieves the patient of retention and reduces the dangers of

generalized infections, it does not prevent the development of infection in the prostatic urethra or bladder which may spread to the surrounding areas by way of the lymphatics. The infection may be carried by the lymphatics to some distant point (iliac, lumbar, kidney, or hypogastric regions) and there set up an extensive suppurative process which is difficult to combat.

The propagation of infection by the lymphatic route serves to explain the development of postoperative suppurations in cases in which there is no history of instrumentation or manipulation following operation. In cases of suprapubic prostatectomy the prostatic bed is poorly drained and may act as fertile soil for pathogenic organisms and thus provide a focus of infection which may spread rapidly by way of the lymphatics.

*Blood stream.* Although there is frequent anastomosis between the blood vessels of the various genito urinary organs and a common source of blood supply for the rectum and some of the genito urinary organs, there is no clinical evidence to show that infection can be carried from one part of the urogenital tract to another by direct vascular connections. It is a well known fact that there are blood channels extending from the bladder to the kidney, yet none of the blood from the bladder goes to the kidney before entering the vena cava. It is possible, however, for a focus of infection in one part of the tract to set up a general blood stream infection and cause a secondary hematogenous infection to another part of the tract.

The role of thrombosis or thrombophlebitis in the extension of infections about the prostate is perhaps of more theoretical than actual interest. It is interesting to note that Englisch has reported a series of so called idiopathic cases of perivesical inflammation, in which the infectious agent was carried to the perivesical region from some distant focus. Culver and Baker likewise suggest a similar explanation for 2 cases of their series.

#### THE RELATION OF THE OPERATIVE PROCEDURE TO INFECTION

The nature of the infection introduced at or following operation varies with the type of operation performed. The occurrence of a

severe infection in the prevesical region following a suprapubic cystotomy or prostatectomy is primarily due to a flooding of the operating field with septic urine. Opening a bladder which is distended with urine or which has been filled with some fluid before operation increases the danger of infection about the base of the bladder.

It is surprising to note that little or no mention is made in the literature of such local complications despite the immense number of cystotomies that have been performed. The fact that these cases are not reported is not a true indication of their rarity but rather represents a reluctance on the part of the surgeon to record a poor result. However, the recent refinements of operating technique and the careful preoperative preparation of the patient may be responsible for the relative infrequent occurrence of such unfavorable complications.

Legueu and Rochet have observed 3 cases of periprostatic and perivesical cellulitis in a series of more than 1,000 suprapubic prostatectomies. Chute has reported 6 cases of perivesical suppuration in which the etiological factor was quite clear. In 1 case, the infection followed a suprapubic cystotomy (for benign hypertrophy of the prostate) in which the prevesical space was infected and inadequately drained. In the other 5 cases the infection followed traumatism of the posterior urethra. Culver and Baker report a series of 7 cases of perivesical suppurations in which one case developed a suppurative lesion completely circumscribing the bladder about 2 weeks after a second stage suprapubic prostatectomy. Of the 6 other cases, 1 was the result of an extension from infected seminal vesicles, 1 from a suppurative cystitis, 2 following surgical trauma to an infected posterior urethra, and in 2 cases the etiological factor was undetermined but was probably the result of a blood stream or lymphatic extension from an infected bladder or posterior urethra. Moschcowitz (quoted by Caulk) reports a case of perivesical suppuration following trocar aspiration for preluminary suprapubic drainage.

The likelihood of a cellulitis developing after a suprapubic prostatectomy appears to

be greater than after a simple cystotomy. The former procedure requires a good exposure of the operative field, a larger incision of bladder, and difficult and often traumatizing manipulations to remove the prostatic growth. Another very likely source of danger and focus of infection in the prostatectomized patient is the dead space created by the removal of the enlarged gland. This space is constantly filled with stagnant and infected urine and when poorly drained provides an excellent nidus for the growth of pathogenic organisms.

The danger of periprostatic or perivesical infection following a perineal prostatectomy appears to be more theoretical than actual, as Young in his extensive series has never had such a complication and, likewise, a review of the literature fails to reveal any cases. The reason for the rare occurrence of these complications is quite obvious. In a perineal prostatectomy, adequate drainage is provided. The gauze pack in the prostatic bed and the bladder drain prevent accumulations of septic urine about this area during the first 48 hours after operation. It is during this early period before a natural barrier to infection in the operative area can be set up that extravasated urine or flood of pathogenic organisms from the bladder and posterior urethra can gain entrance to the loose cellular planes about the prostate and bladder.

Perivesical infections may occur after partial cystectomies for malignant tumors or inflammatory lesions of the bladder, total cystectomies, operations for diverticuli of the bladder, or operations upon the seminal vesicles. The mechanism is essentially the same as after suprapubic cystotomy or prostatectomy. In partial or complete excision of the bladder, the floor or base of the bladder is usually involved and there is an accumulation of urine in the operative area with organisms entering the cellular planes to set up a diffuse cellulitis.

Periprostatic or perivesical suppurations may also develop after any of the following procedures: instrumentation of the urethra; operations upon the urethra, endoscopic or cystoscopic examinations, insertion of retention catheters into the bladder, punch or

cutting operations at the vesical neck and operations for prostatic abscess with incomplete drainage.

When properly sought for, these diffuse infections will explain many of the prolonged septic temperatures that occur after any of the above procedures.

#### LOCALIZATION OF INFLAMMATORY PROCESS

The sites of predilection for localized suppurations following operations on the bladder and prostate are dependent upon the origin of infection and its avenue and manner of spreading. The localization of suppurations around the prostate is closely linked to the anatomical relationship of the prostate and its surrounding cellular spaces.

However, a review of the literature on perivesical infections reveals a marked tendency to use interchangeably and often incorrectly the terms suppurative pericystitis, suppuration of the perivesical space, abscess or phlegmon of the space of Retzius. The terms perivesical and periprostatic suppuration infer the accumulation of pus intimately surrounding or adjacent to the bladder or prostate and confined within the various spaces about these organs by the fascial sheaths.

The type of micro-organisms usually found in perivesical and periprostatic infections are anaerobes, i.e., staphylococcus, streptococcus, and colon bacillus. These organisms are very likely to be found in the infected bladder and posterior urethra and hence may be carried to the pericystic tissues by the blood or lymph channels or directly implanted during or after operation.

These inflammatory collections about the prostate and the base of the bladder are essentially of three types:

1. **Intrafascial** Occurring in any one of the various spaces situated between the true prostatic capsule and the different periprostatic fascias.

2. **Extrafascial** Occurring in the spaces external to the periprostatic fascial planes.

3. **Distant suppurations** The result of extensions of the inflammatory process by way of the blood stream, lymphatics or by direct continuity from the focus of infection in the operative area.

The nature of these infections varies from a localized abscess confined within the fascial spaces about the prostate and bladder to a diffuse cellulitis in the extrafascial planes. The latter group are essentially phlegmons which may spread to distant regions (kidney, groin, thigh, or perineum) and point more or less to an abscess.

In this respect, it is interesting to note the results of Aversenq and Dieulafe in an experimental and anatomical study of prostatic abscess. By means of forced injection of colored gelatin they demonstrated the integrity of each of the periprostatic spaces from the standpoint of possible localization of pathological collections following prostatic abscess. Experimentally they were able to create three types of collections: subcapsular (within substance of prostate gland), posterior periprostatic, and prerectal (Figs 2, 4, 5 and 6).

They noted that subcapsular collections had a tendency to limit themselves but could easily spread into the posterior periprostatic space. They found that collections confined within the posterior periprostatic space could extend up between the seminal vesicles reaching the peritoneal cul de sac and down to the apex of the prostate and the external vesical sphincter. Injections within the prerectal space easily fill the entire bed extending down to the triangular ligament. It was extremely difficult to produce a distention of the lateral periprostatic spaces by the injection. When the anterior periprostatic space was injected the injection mass passed upward into the space of Retzius and even spread into the superior perirectal space. However, it must be borne in mind that their study was primarily concerned with the spread of infection by continuity rather than by the lymphatics or blood stream.

The localization of infective processes following suprapubic operations is quite similar to that which follows the extension of a prostatic abscess, especially when the infection spreads in the fascial planes about the posterior surface of the prostate and bladder. However, the greatest number of local complications following operation are seen in the immediate operative field due primarily to a flooding of this area with septic urine.

*A Intrafascial infections.* The development of an inflammatory lesion in the anterior periprostatic space (Fig 4) is relatively rare following operation due to the fact that the anterior lobe of the prostate is seldom the seat of a pre-operative or postoperative infection. Many years ago Guyon pointed out that from a surgical standpoint there is no prostate in front of the urethra. An abscess in this region may easily be overlooked as it is out of reach of the examining finger in the rectum. Not infrequently, however, an infection beginning in the space of Retzius may spread down into this region. The extension of an inflammatory process from the posterior urethra and prostate to the anterior periprostatic space, brought about by a thrombophlebitic process involving the plexus of Santorini, is possible but not probable.

The lateral periprostatic space area is seldom, if ever, the site of a localized inflammatory lesion before or after operation. The rarity of infection in this region is contrary to expectation in view of the great number of blood vessels and lymphatics which are found traversing the thin connective tissue of the space. It may be that infections occur in this space and are not diagnosed until they spread into other fascial planes. When infection does occur in this space it is usually due to direct extension of the inflammatory process from the retroprostatic and retrovesical planes. In rare instances pathogenic organisms may be carried to this area by way of the blood stream or lymphatics and set up a localized abscess which spreads rapidly to the other fascial planes about the prostate. True lateral periprostatic infections are extremely difficult to recognize by rectal examination, but when extension to other areas, particularly the posterior periprostatic space occurs, the presence of a palpable mass over the posterior surface of the prostate renders the diagnosis easy.

The posterior periprostatic space is frequently the site of an unsuspected abscess following suprapubic prostatectomy. The dead space created by the removal of the prostatic growth provides an excellent medium for the accumulation of virulent bacteria which may spread into posterior fascial



planes by direct extension. The trauma incidental to the suprapubic removal of a prostatic enlargement renders the capsule of the prostate vulnerable to infectious processes. Suppurations beginning in other periprostatic planes may easily extend to this space as aforementioned.

From an anatomical standpoint the posterior periprostatic space may be divided into a retroprostatic and retrovesical area. The retroprostatic area is the *decollable space*—the distensible or separable space of the French writers. This space lies between the capsule of the prostate and the fascia of Denonvilliers and should not be confused with a presumably potential space existing between the two layers of the fascia of Denonvilliers. In the loose cellular confines of this separable space, collections of pus may readily gather and then break through the fascia of Denonvilliers to reach the prerectal space. The retrovesical area is more compact and is less frequently the site of an inflammatory lesion. However, this portion may be the seat of a chronic insidious abscess as a result of an abscess of the wall of the bladder or of the seminal vesicles opening into this space. An inflammatory lesion in the retroprostatic area may spread up into the retrovesical area, but as a rule does not spread beyond the seminal vesicles which act as a barrier.

Abscesses developing in the posterior periprostatic space may spread in a transverse plane around to the anterior and external surfaces of the prostate or in a vertical plane to reach the region of the seminal vesicles upon the base of the bladder or up to the peritoneal fold. The fascia of Denonvilliers serves as a solid barrier limiting the infection within the posterior periprostatic spaces. However, the fascia of Denonvilliers is not uniformly thick and in some regions is a thin cellular aponeurosis which permits infectious organisms to break through and reach the prerectal space.

The nature of the inflammatory lesion in the posterior periprostatic space may vary from a diffuse cellulitis to frank abscess formation and may readily perforate the fascia of Denonvilliers to invade the prerectal

space. A cellulitis within the posterior periprostatic space is essentially a periprostatitis and should be differentiated from an inflammatory lesion of the prerectal space.

**B Extrafascial infections.** 1. Suppuration within the anterior extraprostatic space (more commonly known as the space of Retzius) (Fig. 7) is the most frequent local complication following operations on the bladder and prostate by the suprapubic route. Suppuration within this space should properly be called an abscess or phlegmon of the space of Retzius and should be differentiated from suppurative pericystitis which is an infection covering all sides of the bladder in which an accumulation of pus is anatomically possible. Suppurative pericystitis is most frequently the result of a prevesical space infection which has spread to the retrovesical separable space and involves the entire external surface of the bladder with the exception of a small area on its anterosuperior surface surrounding the attachment of the urachus and the obliterated hypogastric arteries.

In reviewing the literature one is impressed with the striking relation of suppurations of the prevesical space to trauma incidental to operations or instrumentation in cases of stricture of the urethra, whereas but scant reference is made to the development of similar infections following operative procedures upon the urogenital organs. It is interesting to note that frequently a diagnosis of suppurative pericystitis is made in preference to an abscess of the space of Retzius, although the infection usually starts in the latter area as a result of intra urethral and peri urethral inflammations spreading through the lymph channels and glands found in this area. The diagnosis of suppurative pericystitis is based upon the occurrence of a mass in the loose perivesical tissue behind the umbilicoperivesical aponeurosis (posterior layer of the transversalis fascia).

The actual infection in the space of Retzius in this case may be slight but there may be an extensive collection of pus on all sides of the bladder especially in the retrovesical region. Infections in this region are primarily

due to a flooding of the operative field with septic urine. The accumulation of infected urine behind the pubic bone eventually causes suppuration and necrosis of the cellular tissue of this space and may even attack the bone itself. Inflammatory lesions within the bladder or prostate or their adjoining spaces may readily extend to this region either by direct extension or by way of the vascular or lymph channels stream. Following perineal prostatectomy the occurrence of an infection in the space of Retzius is extremely rare and would undoubtedly be carried there by the lymphatics or blood stream.

Case 56 E G white, male aged 64 years. Seven days after admission one stage suprapubic prostatectomy had been performed. A rubber tube was inserted in the bladder and a gauze drain was placed in the space of Retzius. This drain was removed in 3 days. Seventeen days after operation a large abscess developed in the space of Retzius which was more marked to the left of the midline. The abscess was opened and drained. The patient voided through the urethra on the seventeenth postoperative day. Thirty days after operation the original incision was opened wide and adequate drainage established. The patient was discharged from the hospital 57 days after operation with the abdominal wound completely healed and he was voiding entirely through the urethra with good control.

This case illustrates the common type of infection which occurs in the space of Retzius following a suprapubic bladder operation. The infection is the result of infected urine seeping into the prevesical tissues or flooding of the operative field with infected urine at the time of operation. The condition responded well to immediate treatment such as wide incision and adequate drainage.

Case 6792 I H white male aged 83 years was admitted to Sinai Hospital complaining of a swelling over the suprapubic region. The swelling appeared 4 days prior to admission. It was accompanied by a marked frequency of urination, urgency and unbearable burning on urination. A suprapubic prostatectomy had been performed 4 years prior to this admission. At the time of the first operation there was delayed healing of the suprapubic wound with a persistent suprapubic urinary fistula. Following his discharge from the hospital he complained of urinary discomfort for a long time. On examination at the time of this admission the essential findings were (1) that his urine contained a great deal of pus and (2) that an indurated mass measuring 5 by 8 centimeters was present in the suprapubic

region. The mass was exquisitely tender on pressure. Patient was very toxic.

A provisional diagnosis was made of a suprapubic abscess resulting from an extravasation of urine. This was incised the following day and thorough drainage of the space of Retzius was established. The abscess was confined to the space of Retzius. There were no pockets leading down alongside of the bladder or prostate posteriorly. Patient died 48 hours after operation. No autopsy was obtained.

This case represents a rather unusual condition in that the abscess developed 4 years after the original operation. Undoubtedly the infection in this case was the result of a very slow extravasation of urine through the old urinary fistulous tract. The delayed healing of the suprapubic wound and the persistent suprapubic urinary fistula were the primary etiological factors in the development of this abscess in the space of Retzius. As far as could be determined by rectal examination and findings at the operating table there was no involvement of the lateral or posterior surface of the bladder or prostate. The persistent suprapubic urinary fistula after the first operation, may have been due to an obstruction at the vesical neck following the prostatectomy, but inasmuch as the patient failed to return for examination following the operation this condition could not be ruled out.

Inadequate drainage of the space of Retzius following suprapubic operations predisposes to the collection of stagnant urine in this area, and often in spite of good drainage of this area septic urine will accumulate due to the uphill direction of the drainage. Fortunately inflammatory lesions in this space are readily recognized and respond well to treatment.

Occasionally the infectious process is a virulent one and may attack the posterior surface of the pubic bone denuding the periosteum and setting up a true osteitis. Beer believes that the infection of the periosteum is most frequently the result of injury to the periosteum by traction on the attached muscles but occasionally may be due to direct bruising of the periosteum by drainage tubes.

The erosion of the bone is often visible roentgenographically in the advanced stages

and must be differentiated from carcinoma tous metastases. Clinically the bone lesion is diagnosed because of pain on movement of the pelvis and tenderness upon pressure over the affected region. Often the infectious process may infiltrate the muscles of the thigh passing under the adductor group or attacking their attachments to the pubic bone. Such cases present symptoms of an arthritis of the symphysis pubis. The patient assumes an attitude of slight flexion and adduction of the thigh. Pressure upon the pubic bone or the inferior ramus of the pubis or the muscles in front of or below the bone is extremely painful. The patient restricts his movements as any motion of the legs, thighs, or pelvis is painful. This condition is frequently accompanied by general symptoms and often leads to septicæmia.

The condition is a rare complication. Beer states that he has seen 1 or more cases every year during the period between 1916-1928. We have seen 4 such cases which fortunately recovered following curettement, adequate drainage, and external heat or diathermy. In cases of prolonged infection behind the pubic bone with protracted infiltration of the muscles attached to the pubis, degenerative changes within the muscular components such as atrophy or calcification may be noted presenting in rare instances a picture simulating myositis ossificans.

Case 485. H. T. white male aged 64 years. A one stage suprapubic prostatectomy was performed on this patient 19 days after admission to the hospital during which time he was drained with a retention catheter in his bladder. At the time of operation the space of Retzius was drained with iodoform gauze. Seven days after operation the wound showed evidence of necrosis. Culture from the wound revealed *bacillus coli communis*. There was delayed healing of the suprapubic wound. Attempts to hasten closure of the wound were tried by the following methods: curettement, external application of heat to the wound, and insertion of a retention catheter into the bladder to keep the urine away from the wound. Urinary drainage from the wound persisted for 51 days. Patient was discharged from hospital in good condition with wound closed.

He was readmitted to the hospital 37 days after his discharge complaining of an intense pain in the suprapubic region. The slightest movement of the pelvis or legs was extremely painful. There was

marked tenderness along the symphysis pubis and the inferior ramus of the pubis. An X-ray picture at this time revealed small areas of bone destruction over the pubic bone on the right close to the symphysis suggesting an osteitis or osteomyelitis (Fig. 10). The suprapubic wound was curetted on several occasions, penetration being made as deep as possible while the bone was being curetted. The lower end of the incision was reopened and drained. Hot applications, Alpine lights and massage were also employed. Diathermy was used every day for 8 days. These treatments were continued for a period of 2 months when the condition finally subsided and the wound was closed. Patient has been well ever since his discharge from the hospital.

This case illustrates the type of infection that may occur following a suprapubic prostatectomy. The infection originally started in the space of Retzius and then, progressing downward, involved the posterior surface of the pubic bone, setting up an osteitis of this bone, a rather uncommon sequela which was clearly demonstrated by a roentgenogram. The original source of infection was probably the infected urine draining from the bladder which seeped down to the tissues and set up an inflammatory process in the space of Retzius. This case showed typical signs of arthritis of the symphysis with involvement of the adductor muscles of the thighs. The postoperative course in such cases is protracted and response to treatment is slow. External applications of heat to the suprapubic region, diathermy, Alpine light therapy, and curettement of the infected area and the bone offer the best results.

Case 2732. H. W. R. white male aged 58 years. A suprapubic cystostomy and a bilateral resection of the vas deferens was performed 19 days after admission to the hospital during which time the patient's bladder was drained with a retention catheter. The urine was infected at the time of operation. The space of Retzius was drained for 3 days with a loose iodoform gauze drain. The bladder was drained with a suprapubic tube placed high up in the bladder incision. Twenty seven days after preliminary drainage a second stage suprapubic prostatectomy was performed. The space of Retzius was opened during this operation and drained with iodoform gauze for 3 days. The prostatic bed was packed with iodoform gauze. A moderate amount of bleeding was encountered at operation. No tube was inserted into the bladder. All drains were removed 3 days after operation. Peginning 6 days after the removal of all drains and for 10 days thereafter the patient complained of pain along the

inner aspect of the right thigh, and also in the right inguinal region. The upper end of the cut was deferred on the right was indurated and tender. At this time it was felt that the patient had a right vasitis. Hot compresses were applied to the affected part. The urinary drainage from the suprapubic wound ceased after 26 days, but a seropurulent discharge continued from the wound. At this time (the twenty-sixth postoperative day) tenderness was present over the symphysis pubis and the patient complained of pain on moving the thighs. The wound was curetted down to the posterior surface of the pubic bone. The patient was confined to his bed and received constant hot compresses with numerous curettements for a period of 55 days. Subsequent to this time the suprapubic wound finally closed 108 days after his prostatectomy. Fourteen days after the closure of the wound (the one hundred and twenty-second postoperative day) a fluctuating mass was felt over the symphysis pubis. Aspiration revealed free pus. An incision was made and this area was drained for 26 days; a permanent closure finally resulting with no residual tenderness or swelling in the suprapubic region.

This is another uncommon type of case in which the injection did not remain localized in the space of Retzius but involved the posterior surface of the pubis giving rise to a severe peri osteitis with some involvement of the adductor muscles. This occurred despite the necessary precautions taken at the operating table, namely thorough drainage of the space of Retzius, loose closure of the abdominal wound, and placing of a suprapubic tube high in the bladder incision. The development of an abscess in this region is undoubtedly the result either of the flooding of the operative field with infected urine or of a persistent leakage of urine into the loose cellular spaces anterior to the bladder following the operation. The patient presented typical signs and symptoms of an arthritis of the symphysis pubis such as pain on moving of the legs, tenderness on pressure over the pubic bone, and flexion and adduction of the legs while in bed. The response to energetic treatment was slow but adequate drainage of the space of Retzius after thorough curettement of the infected area resulted in a permanent closure of the suprapubic wound.

Case 2465. J. M. white male aged 57 years. Suprapubic cystostomy was performed 4 days after admittance to the hospital. This was done early because the catheter drained poorly and the patient

began to run a septic temperature. At the time of operation a drain was placed in the space of Retzius and a tube was placed in the bladder. Fourteen days after this while the condition of the patient was improved, the wound broke down. Nineteen days after the first date the prostate was removed. The space of Retzius was drained and the prostatic bed packed with gauze drains. All drains were removed 4 days after the operation. Three weeks after the second operation the patient began voiding through the urethra. A purulent discharge was draining from the suprapubic wound. Two months after the prostate was removed a left epididymitis developed for which an epididymectomy was performed. The suprapubic wound discharged pus continuously for 3 months and the patient presented signs and symptoms of an osteitis of the pubic bone. Finally one hundred days after the second stage prostatectomy the wound healed completely.

This is the third case in this series in which the infection spread from the space of Retzius to the pubic bone giving rise to an osteitis and involving the adductor muscles. This patient presented the same symptoms as the two other cases described above. It was only after thorough curettement of the pubic bone that the wound closed, removing a disability which lasted more than 4 months from the time of operation.

Occasionally an infectious process in the space of Retzius responds poorly to treatment or is neglected and there develop hypogastric or ilio pelvic infiltrations. The inflammatory process may spread on each side to the iliac fossa or the inguinal canals, or down to the pelvic walls to enter the obturator canal and to extend under the adductors of the thighs or down to the base of the bladder or prostate.

2. The lateral extraprostatic space (Fig. 4) is commonly described as the superior pelvic rectal space and corresponds to the whole lateral surface of the prostate. This space is seldom the site of a primary postoperative infection. However, it frequently represents the fusion place of suppurations extending from the space of Retzius, the anterior or posterior periprostatic spaces. In rare instances small abscesses of the lateral lobes of the prostate, the base of the bladder, or the seminal vesicles may open directly into this space.

Suppurations within the superior pelvic rectal space are prone to occur before opera-

tion, developing during the course of preliminary drainage of the bladder by a retention catheter. An infected posterior urethra or prostate may easily be a source of infection and reach the superior pelvirectal space through the lymphatics. The interrelation of genital infections and concealed pelvic rectal suppuration has recently been stressed by Morrissey.

The diagnosis of suppuration within this space is confirmed by a palpable mass involving the lateral and superior surfaces of the prostate and frequently covering the posterior surface of prostate and seminal vesicles. The infection within this space may extend downward and break through the levator ani muscles to enter the ischiorectal fossa.

3. Suppurations within the posterior extra prostatic space (prerectal space) (Fig. 5) are of frequent occurrence before or after operation due to the tendency of the suppurations of the prostate and seminal vesicles to spread posteriorly into the posterior periprostatic space and thence pierce the fascia of Denonvillier to reach the prerectal space. Retroprostatic and retrovesical suppurations naturally tend to open into the rectum and effect a clinical cure, but in some instances the drainage through the rectum is insufficient and the suppuration extends along and around the rectum to point as an ischiorectal abscess or to spread upward under the peritoneum forming a retroperitoneal suppuration.

*C. Distant suppurations.* Anteriorly infections within the space of Retzius may extend up along the abdominal wall traversing the cellular planes above or below the recti muscles. These infiltrations and suppurations may spread over the entire abdominal wall involving the hypogastric, the inguinal, or the lumbar regions but fortunately they are amenable to treatment.

Laterally suppurative lesions about the prostate bed or posterior urethra develop as the result of infection in the dead space created by the removal of the prostatic enlargement. The infection spreads to the superior pelvirectal space and thence into loose subperitoneal space extending in all

directions. It may diffuse toward the inguinal or sacral canal, iliac fossa, and lumbar regions.

Occasionally a diffuse cellulitis originating in the space of Retzius may descend along the wall of the pelvis to reach the fascial planes about the prostatic bed. From this region they may pass out of the pelvis through the sciatic or obturator openings to reach the perineum or thigh. This type of complication has an extremely grave prognosis as the inflammatory process is diffuse and extensive and practically always ends in a septicæmia.

As previously mentioned, suppurations in the superior pelvirectal space may descend and break through the levator ani muscles to the ischiorectal space.

Posteriorly, suppurations within the periprostatic space may extend up to the retrovesical region and continue in an upward or lateral direction under the peritoneum. The inflammatory process may pierce the peritoneum and set up a true pelvic peritonitis. Retroprostatic and retrovesical suppurations may become walled off and traverse the prerectal space to empty into the rectum. It is the natural tendency for prerectal suppurations to perforate the rectal wall and effect spontaneous cure by drainage through the rectal cavity. However, on occasion, a prerectal suppuration may burrow around the rectum and descend down into the ischiorectal fossa or spread up under the peritoneal coverings of rectum following the line of least resistance.

In most of the foregoing types of postoperative infection, the propagation of the inflammatory process is by direct extension along the fascial planes. Occasionally the development of subperitoneal abscess of hypogastric, iliac, inguinal, lumbar, or kidney regions is dependent upon a lymphatic extension. Morrissey reported 2 cases of perirenal abscess in which the infecting agent was carried by the lymphatics, one was secondary to trauma of the posterior urethra and was complicated by an early superior pelvirectal abscess, the other was secondary to a punch operation on the vesical neck. In rare instances, a lymph gland drawing a par-

ticular infected area may become the seat of a localized abscess which may spread to the adjacent subperitoneal tissues as occurred in a case of an iliac abscess following abscess of the prostate, which was reported by Bazy in 1893

The possibility of extension of an infection along the length of an organ traversing the infected area, particularly the vas deferens and the ureter, must be borne in mind. In such cases, the infection may extend by way of the lymphatics accompanying such a hollow organ, or through the loose cellular tissues surrounding it, or through the lumen of the tubular structure. In this respect it is interesting to note the Herman's case of perineal abscess occurring one week after insertion of an indwelling catheter for benign hypertrophy of the prostate where the infection was apparently due to a peri ureteral extension of the pus from below upward and not by way of the lymphatics

#### PREVENTION AND TREATMENT OF POSTOPERATIVE INFECTIONS

Fully cognizant of the serious and often grave consequences of postoperative infections, the surgeon is forewarned to guard against their appearance and to institute immediate and energetic treatment to eradicate them when such unpleasant complications arise. Fortunately, the occurrence of local and distant suppurations following suprapubic operations is rare. However, despite the careful preoperative preparation of the patient and the refinement and perfection of operative technique in recent years, we venture to say that postoperative infections are relatively more common than a survey of the literature would indicate.

Many operative precautions have been suggested by different surgeons with the thought in mind that the prevention of local complications is necessary to insure a speedy recovery and a perfect end result. In a well planned and executed suprapubic cystotomy and prostatectomy, the following steps are of great importance: good exposure of the bladder, proper incision of the bladder, careful closure of the suprapubic wound with adequate drainage.

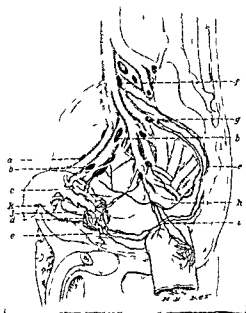


Fig. 8 Lymphatics of the prostate seminal vesicles and vas deferens (after Cuneo and Marcille). *a b* External iliac glands *c* efferent trunk from prostate to external iliac glands *d*, retroprostatic glandular nodules *e* efferent trunk from prostate to gland of promontory *f* gland of the promontory *g* laterosacral gland *h*, middle hemorrhoidal gland *i* middle hemorrhoidal trunk *j* seminal vesicles and *k* ureter

**Exposure of the bladder** One of the most important factors in eliminating postoperative infections is a careful and neat exposure of the bladder. Great care should be exercised in stripping the peritoneum off the bladder, as frequently the dissection is carried too far laterally and caudally, creating a retroperic dead space and exposing the neck of the bladder to unnecessary trauma. The superior border of the pubic bone should serve as the landmark for the lower limit of the exposure of the bladder in a suprapubic cystotomy or prostatectomy.

To prevent subperitoneal and prevesical space infections, Neff as well as other surgeons, performs a preliminary operative procedure such as suturing the bladder to the skin or to the under surface of the rectus sheath and waiting 4 or 5 days until adhesions have closed off the prevesical space before opening the bladder. These same precautions

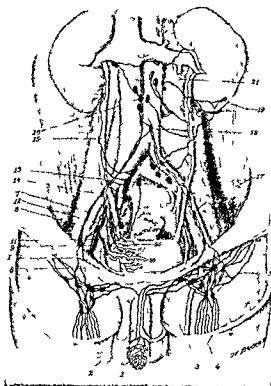


Fig 9 Lymphatics of glands penis posterior wall of the bladder ureter and renal capsule 1 Lymphatic vessels of glands and penis 2 lymphatic vessels of dorsum of penis and collecting trunks for lymphatic of glands 3 collecting trunk for lymphatics of penis to the inguinal lymph glands 4 lymphatics of thigh 5 inguinal lymph glands 6 collecting trunk from lymphatics of penis to external chain of iliac lymph glands 7 external chain of iliac glands 8 middle chain of iliac glands 9 internal chain of iliac glands 10 lymphatics of posterior wall of bladder 11 collecting trunks for lymphatics of bladder to iliac lymph glands 12 hypogastric glands with efferent lymphatics from bladder 13 gland of the promontory 14 lateral sacral glands with efferent lymphatic from seminal vesicles 15 ureter with lymphatics of the middle third 16, pre aortic lymph glands 17 iliac lymph glands 18 lumbar lymph glands 19 lymphatics of renal capsule 20 interrupting nodules (Shalldreusen) 21 juxta aortic glands 1 & 4 internal inguinal ring

may be carried out equally well at the time of the major operation before the bladder is opened

**Incision** The type of bladder incision used is often the determining factor in the speed of convalescence and the final result. In a simple cystotomy, the incision should not be carried too far down

toward the neck of the bladder. The incision should be large enough to permit the introduction of the suprapubic tube and as a rule should not exceed 3 centimeters. In a suprapubic prostatectomy the incision is of greater length in order to facilitate the removal of the prostatic growth. The incision may be enlarged in the direction of the fundus of the bladder or in a transverse direction. Some surgeons make their skin and bladder incisions entirely in a transverse direction depending upon retraction of the incision for adequate exposure. The transverse incision is particularly applicable to the open method of suprapubic prostatectomy.

It is imperative to safeguard against a sudden flooding of the operative area at the time of opening the bladder by carefully packing off the prevesical space or by introducing a cannula with or without a suction apparatus attached before incising the bladder. The bladder may be distended with air or washed out with sterile water prior to operating, to minimize the sudden outflow of pathogenic organisms. The value of pre-operative drainage of the bladder through an urethral catheter in reducing bladder infection is, of course, obvious.

**Closure** The important feature of the closure of the abdominal wound is adequate drainage of the space of Retzius by a wick or gauze drain placed at the lower end of the incision. A moderately loose closure of the wound insures better drainage. The suprapubic tube should be brought out in the upper part of the bladder and abdominal incisions to prevent the seeping of infected urine into the lower angle of the incision. Experience has shown that the placing of the suprapubic tube at the upper end of the bladder incision incurs little danger of infection of the peritoneum in this region. In old infected prostatic cases, it may be necessary to drain the prostatic bed perineally.

**Treatment** Despite these operative precautions there may occasionally develop signs of infection in the various areas about the bladder and prostate due to the fact that surgical drainage in these cases is in an uphill manner and hence inadequate. One should not delay treatment until the classical signs

of suppuration are manifested but should institute immediate measures at the earliest evidence of infection, such as an unexplained persistent rise in temperature or pain on pressure in the region of the abdominal wound. It is folly to await the development of a suppurative process behind the pubic bone in the face of such symptoms and one should immediately institute drainage of the prevesical space. Often opening widely the lower angle of the abdominal incision with frequent lavage and irrigation supplemented by thorough drainage will clear up these impending infections. Occasionally, however, one must resort to perineal drainage of the prevesical space. The essential factor of such dependent drainage is the accurate placing of a drain which passes in front of the bladder behind the pubic bone to reach the inner side of one of the inferior ramus of the pubic bone. This procedure is a relatively simple one and has been advocated by Legueu. He makes a small incision of 5 to 6 centimeters on the inner aspect of one of the inferior ramus of the pubis and proceeds with his dissection into the ischio-rectal space. A finger is then inserted in this space in an upward direction to reach the tip of a curved sound or a long Kelley clamp, which is introduced beforehand behind the pubic bone and pushed down the prevesical space into the perineum to the internal side of the inferior ramus of the pubis. When the end of the sound or clamp is palpated a small incision is made over its end and the instrument brought out through the perineal opening and a drain is grasped or attached and brought back to the retropubic region. In this procedure one must avoid injury to the inferior ramus and to the corpus cavernosus. When the infection is confined to the prevesical space unilateral perineal drainage will suffice but when the infiltration has spread around the base of the bladder a similar drainage on the other side of the perineum should be made in order to drain properly the lateral and posterior surfaces of the bladder. When the infection has spread beyond the confines of the prevesical space down the inguinal canal or passes out of the obturator foramen to the deep parts



Fig. 10. Roentgenogram showing periosteitis and osteitis of the pubic bone following suprapubic prostatectomy.

of the inner thigh, it is necessary to supplement this subpubic perineal drainage with appropriate incisions and counter incisions at the most prominent points of localized suppurations.

The foregoing treatment of prevesical and retropubic infections is particularly efficient in cases following suprapubic cystotomy. However, after a suprapubic prostatectomy one must consider the prostatic bed as an additional source of infection. When the surgeon is reasonably assured that the prostatic bed is serving as the focus for the septic process, perineal drainage should be performed, the typical perineal approach to the prostate as described by Young being used. The fascial spaces about the prostate and bladder should be explored digitally and the capsule of the prostate incised. One or more drains should be passed through this opening in the prostatic capsule into the bladder to provide adequate dependent drainage of the bladder and prostatic enucleation cavity. It is advisable to drain the posterior peri-prostatic space by placing drains up to the posterior aspect of the prostatic capsule.

In the cases of slowly developing infections which occur in the late stages of convalescence one must be prepared to combat a prevesical or perivesical cellulitis or a diffuse



pelvic suppuration which may extend by way of the lymphatics to the inguinal, iliac, lumbar and thigh regions. These conditions are often fatal and require radical intervention to prevent the development of a septicæmia. The primary focus of infection must be attacked before one can hope to relieve the secondary suppurations developing in sites remote from the bladder or prostatic regions as these latter places mark the point of exit for infections. Consequently one should reopen and thoroughly explore the prevesical space and search for a hidden retropubic infection following suprapubic cystotomy. A perineal retropubic drainage should be performed in the manner afore mentioned to establish dependent drainage of the areas about the prostate and bladder. If these complications occur following a suprapubic prostatectomy perineal drainage of the prostatic bed should be supplemented. The secondary suppurations at distant sites should be incised and drained according to their degree and rapidity of formation.

For cases of osteitis of the pubic bone with infiltration of the muscles attached to the pubis giving rise to arthritic symptoms, we have obtained good results with quartz light therapy, diathermy, and massage used in conjunction with good drainage and curettage of the operative area.

### CONCLUSIONS

1. A knowledge of the anatomical relations of the posterior urethra, prostate and bladder, and their fascial coverings is essential to a complete understanding of the infectious processes after suprapubic operations.

2. The postoperative infections about the prostate and bladder are the result of inflammatory processes propagated by direct extension and by the lymphatics. The blood stream is rarely the pathway of infection.

3. Infection of the prevesical space is the most frequent complication of suprapubic cystotomy and in most instances is due to a flooding of the operative field with septic urine introduced either at the time of operation or during convalescence.

4. Osteitis or periosteitis of the pubic bone is a distinct clinical entity and may

develop after any suprapubic bladder operation.

5. Immediate treatment should be instituted at the earliest signs of impending infection.

6. When the infection has spread beyond the confines of this space to the region about the neck of the bladder, the subpubic perineal approach as advocated by Legueu provides adequate dependent drainage of the prevesical and perivesical region.

7. The proper treatment of local or distant suppurations following suprapubic prostatectomy requires early recognition of the fact that the prostatic bed is usually the source of such infection and demands immediate drainage of this area.

8. The perineal approach offers the best surgical drainage of suppurations about the prostatic bed.

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TEMPORARY DIVERSION OF THE URINE BY PYELOSTOMY  
IN REPAIR OF THE URETER<sup>1</sup>MARC ISELIN, PARIS FRANCE  
Hôpitaux de Paris

THE end results of attempted repair of ureters injured during the course of gynecological or other pelvic operations have generally been disappointing. It is almost an axiom, at least to French and German urologists, that once the ureter has been severed the kidney is for all practical purposes an irreparable loss. Even if the absence of a severe infection obviates immediate nephrectomy, total functional loss is eventually to be expected due to degeneration of renal tissue as a consequence of the disturbance of urinary excretion.

The danger of infection may be appreciated when one considers the unavoidably septic operative field usually encountered in such pelvic conditions as salpingitis, carcinoma of the cervix, and so on. Injuries to the ureters are seldom reported and the time elapsing before the appearance of recognizable post-operative infection may vary from a few days to several weeks, especially in the presence of a ureterovaginal fistula. The seriousness of this latter complication in a patient already weakened from an extensive and difficult operation may be considerable. Weibel for instance reports 66 cases of ureterovaginal fistulae following operative injuries among which were 8 nephrectomies for pyonephrosis and 8 deaths. Pasteau reports one such case as having been saved by secondary nephrectomy. Marion reports that in 3 patients within 2 to 8 weeks after ureterovesical implantation, there were 3 deaths due to pyonephrosis. Deniker and Le Gac report nephrectomy revealing a cystic and infected kidney 2 months after ureteral repair. Finally, Delbet cites a case in which extraordinary difficulties were encountered during the course of a secondary nephrectomy, the kidney being involved in such extensive perinephritis that the inferior vena cava was unwittingly ligated and cut.

In the absence of any infection, renal degeneration nevertheless inevitably super-

venes upon ureteral obstruction. According to Hinman the mechanism of this degeneration depends upon a preliminary ureteral dilatation followed by a subsequent atrophy of the renal parenchyma. Progressive changes in two such stages are seen in the cases reported by Ash in one of which the patient never having suffered any difficulty had been considered cured until a cystoscopic examination revealed the absence of ureteral peristalsis and complete obstruction to the ureteral catheter on the side operated upon.

Stenosis of the ureter may develop very slowly. In the case reported by Chaton, the ureter remained patent and the kidney showed normal function for almost a year before the ureter became obstructed. Du Janier reports a case in which 5 years after operation the affected kidney showed 50 per cent normal renal activity but in which within another 5 years the ureter had become completely obstructed.

When degeneration takes place, in spite of the patency of the ureter, the etiological solution of the problem becomes very difficult. In the case reported by Lenormant the ureter could be catheterized but the kidney excretion was found to be only one third normal. In general, however, renal atrophy is a slow development. Marion reports a case in which the ureter remained patent for 19 years, the kidney meanwhile gradually having lost all functional value and showing upon removal complete hydronephrotic degeneration and even the presence of a small and unsuspected carcinoma. Similarly a kidney examined by Descomps 27 years after a reparative operation was found entirely cystic. Later we shall discuss certain theories in regard to these cases of slow degeneration.

It is clear that one must be extremely conservative in appraising the results of ureteral repair. An attempt at such repair can be deemed successful only when catheterization is possible and kidney function normal on the

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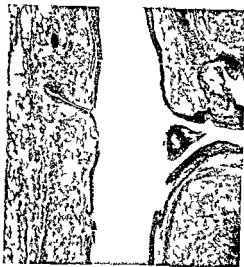


Fig. 1. Longitudinal section of repaired ureter showing perfect healing of mucous and muscular layers on the left and prevention of such healing on the right due to eversion and interposition of mucosa caused by incorrectly placed suture  $\times 25$

side operated upon. Observations over long periods and including these indispensable tests are few because patients not actually suffering hesitate to return to the surgeon for only routine cystoscopy and ureteral catheterization.

In brief, in accordance with the view that loss of kidney function inevitably follows at tempted repair of the ureter most surgeons consider anastomosis of the severed ureter in advisable believing that the kidney should be removed.

Marion and Legueu even go so far as to state that suture of the ureter is not only useless but distinctly dangerous in view of the high percentage of infectious complications ultimate destruction of renal function being inevitable at best. The basis of such an assumption, however, is questionable for after all we know very little concerning the real cause of secondary renal degeneration and a hasty routine nephrectomy is in itself not without danger.

In considering the dangers of nephrectomy, it need hardly be mentioned that the primary danger is in the removal of a kidney in cases in which the actual functional condition of the remaining kidney is not known and especially in cases in which there is reason to believe it impaired. Injury to the ureter in a

gynecological operation occurs only in difficult cases as in dealing with tumors of the broad ligament where there is more or less alteration in the normal anatomical relations. The ureter in such cases may cross the tumor and be surrounded by dilated veins from which it is quite indistinguishable (Gosset). Similar difficulty may be encountered in an old adherent salpingitis in which separation of the tube necessitates a procedure called "American" in France and which, according to Lenormant and Leibovici, is most dangerous for the ureter. The operative treatment of carcinoma of the cervix is not without danger especially when extensive infiltration forces the surgeon literally to dissect the ureter from the parametrium. Moreover, in each of these cases the ureter may be so displaced and compressed that renal function is seriously interfered with.

On the other hand, certain carefully examined cases followed over a long period have been reported in which the renal function has shown little if any impairment. Classic examples of such comparatively successful attempts at ureteral repair are those of Reed, Delbet, Brizacki, Friedrich, Bournot, and more recently those of Rochet, Lenormant and Leibovici, and Chifelhau. Chifelhau's case is particularly instructive for when the patient was examined 19 years after ureteral repair both ureters were found patent and kidney function tests showed insignificant difference between the two sides. Similarly both kidneys in a patient operated upon by Petit were found after 18 months to be identical in functional value. With evidence such as the foregoing there seems to be little basis for rejecting repair of the ureter as a procedure which may afford a long period of good functional activity if not an actual recovery.

The disturbance in urinary excretion following ureteral injury presents a problem to be solved on either a physical or a physiological basis. Dilatation and renal degeneration as a consequence of ureteral stenosis would seem to involve a physical factor while paralysis of the smooth muscle of the ureter might appear purely physiological. Marion considers the paralysis to be due to section of the muscle fibers and interruption of their con-

tinuity by scar tissue. In the severed ureter both ends may be observed to contract more or less feebly even when completely isolated. In the repaired ureter, however, peristaltic waves do not pass through the scar at the line of anastomosis.

On a physiological basis the inertia of the ureter and the renal atrophy, in spite of a patent ureter may easily be explained, urine being excreted only when pressure within the kidney pelvis exceeds that within the bladder, all the work of excretion is thrown back on the kidney thereby profoundly disturbing its secretory mechanism. In such event repair of the ureter would be useless since it has presumably proved fatal to the physiological mechanism of both excretion and secretion. In the present investigation, however, careful consideration of these very points of pathological physiology has led to quite an opposite conclusion, namely, that stenosis is the cause of ureteral inertia, the inertia being an immediate consequence of the dilatation following the repair. Stenosis, therefore, must be prevented, and the difficulty encountered in its prevention is in direct proportion to our ignorance of its causes.

Analogy between the present problem and that concerned in traumatic rupture of the urethra comes naturally to the mind, for whenever one or other of the urinary ducts is severely injured stenosis is the usual sequel. With few exceptions, until the urine was diverted by cystotomy, the results of urethral repair were deplorable. Stenosis accompanied by general dilatation of the upper urinary tract occurred and was followed by renal insufficiency, infection, and finally by death. After Rochet, Marion, and Heitz Boyer had demonstrated the advisability of systematic diversion of the urine by preliminary cystotomy, the results of urethral repair uniformly improved leading one to conclude that the passage of urine over the suture line must be prevented during the period of cicatrization.

Diversion of the urine from the urethra by cystotomy is comparatively easy, an analogous diversion from the ureter is quite another problem. Hinman attempted ureteral diversion by simple nephrostomy in a case of chronic cystitis but although the kidney was

kept open for 3 months and a small quantity of urine flowed outside there was no improvement of the bladder disturbance until permanent ureterostomy was performed. Similarly pyelostomy, even with the maintenance of a tube in the kidney pelvis, has proved inadequate for complete drainage. The operative opening has a strong tendency to spontaneous closure as have all such fistulae connecting with an open tract, a tendency well recognized in surgery and seen for example in the spontaneous closure of such fistulous tracts as gastro enterostomy in the absence of pyloric obstruction of the common duct after biliary drainage, of intestinal fistulae following the relief of obstruction, and of a pyelostomy after removal of a calculus. Moreover, one may make use of these same examples in arriving at the opposite generalization that a fistula will stay open as long as the normal excretory passage is obstructed, a generalization which forms an important basis for the present experimental work. A bougie of sufficient caliber to block the ureter having been introduced distally through the opening of a pyelostomy, the urine may readily be diverted through a catheter in the renal pelvis introduced through the same opening and the fistula will show no tendency to close as long as the normal course of the urine is obstructed but will close at once upon removal of the bougie from the ureter.

#### THE EXPERIMENT

The present experimental research has been carried on in general from two aspects first, consideration of the surgical value of temporary urinary diversion, and second, consideration of the physiology of the repaired ureter. Before discussion of the conclusions drawn from the experimental data obtained the actual operative technique of the various essential procedures will be described.

#### OPERATIVE TECHNIQUE

*Pyelostomy.* The kidney having been exposed by lumbar incision the renal pelvis is opened and a No. 8 to No. 12 bougie, according to the size of the experimental animal, is introduced downward into the ureter. The bougie is held in place by a transfixing suture

with avoidance of unnecessary trauma to the ureter, and a small catheter is inserted just within the kidney pelvis. In the closure of the wound it is essential in the dog that along the posterior side of the kidney be placed a strip of gauze which before its removal in about 5 days markedly favors the formation of adhesions between the kidney and the posterior abdominal wall and thus largely removes the danger of peritonitis. In the closed operative wound one sees the bougie at the upper angle and the catheter and gauze strip at the lower angle. The bougie and catheter must be cut so as to project about half an inch outside the incision in order to allow for displacement of the kidney when the animal is up and to prevent the animal from tearing out the tubes.

*Repair of the ureter* In the present experimental work end to end anastomosis of the ureter was employed. This type of repair seems more suitable in clinical surgery than anastomosis by invagination or by lateroterminal implantation even though good results by these latter methods have been found by Bloodgood in experimental surgery. The mere method of anastomosis, however, is not the solution of the problem of ureteral repair, for were it so the problem would long since have been solved judging from the many ingenious methods which have been published (Bier, Young). The author believes that the solution lies in diversion of the urine, and consequently the simplest and most rapid technique of repair, namely, end to end anastomosis must be employed.

Following lateral laparotomy the ureter is mobilized and carefully sectioned after being isolated on a Kelly clamp. The ureteral vesicles which are preserved prevent excessive spreading of the severed ends. Four fine black silk sutures are passed inward through the lower end and outward through corresponding quadrants in the upper end. By this procedure sutures in each quadrant evert the mucosa and have their knots outside of the ureter. The necessary ectropion of the mucous membrane caused by this technique presents difficulties which, however, are not insurmountable. The photomicrograph (Fig 1) shows a striking illustration of this diffi-

culty. On the left side the sutures have been correctly placed, close to the ends of the ureter. There is no ectropion and one sees how much more readily muscular repair takes place where there is no interposed fibrous tissue or mucosa than where re-establishment of muscle fiber continuity is prevented by such everted layers. On the right side, the first suture to be placed had broken while being tied. A second suture placed with greater difficulty included too much of the tip of the ureter and caused eversion of the mucosa in the form of a true mucous channel making cicatrization impossible. Since mucosa was approximated to mucosa a partial fistula with inflammatory reaction ensued and epithelium proliferated outside of the lumen along the adventitia of the ureter. With an everting suture it is difficult to avoid ectropion, and an inverting suture which would at once constrict the lumen of the ureter could not possibly be employed. However, were the mucosa of each ureteral extremity destroyed by careful use of the thermocautery to just the extent to be included in the suture, anastomosis would unite muscle layer to muscle layer and bring together the edges of normal mucous membrane. Such procedure would favor quick repair and even were there a break in the continuity of the mucosa it would be regenerated completely within 5 days as reported by Kramer. This was also observed in this series.

## RESULTS

The preliminary procedure of pyelostomy with temporary obstruction of the ureter was performed on 12 dogs. In the first series, animals 5 to 10, postoperative peritonitis was fatal in each case. In the second series, animals 4 and 11 to 16, a gauze strip was used as described above with one operative death, dog 16. Dog 4 died after 31 days from a retroperitoneal infection. Dog 15 died on the fifty-fourth day. The cause of death was not determined.

In each case the fistula functioned perfectly for 4 or 5 days, a period varying with the amount of activity of the animal and with the degree of the unpreventable infection at the site of operation. The presence of the catheter

in the renal pelvis was found non essential and was not used in the last three animals, the fistulæ functioning perfectly as long as the bougie was not displaced. Within 24 hours after the bougie was withdrawn, however, not a drop of urine appeared at the opening. Eight to 15 days were usually necessary before complete healing of the wound, again the result depending on the degree of infection. Infection is, of course, a great hindrance to good experimental results and incisions which have been drained seem always to become infected under experimental conditions. The dog, moreover, is not the most favorable subject for the study of ureteral repair, for in the absence of infection the results are always good, as shown by the work of Bloodgood, Alskne, Gouverneur, and Kramer.

Although the results of the foregoing procedure show that temporary pyelostomy will remain open as long as an artificial obstruction is in place and that it will close spontaneously upon withdrawal of the obstruction, there is no warrant for any far reaching deductions concerning the usefulness of the procedure in repair of the ureter since the experimental conditions encountered were so unfavorable.

In order to follow the processes of ureteral repair, a certain number of animals were sacrificed at regular intervals after anastomosis. With a wide opening of the abdomen it could easily be seen that contractions of the ureter were present and could be stimulated by pinching. Under ether anæsthesia, kymograph records of ureteral contractions were made by means of a technique modified from that of Penfield. Four superficial sutures were passed through the ureteral wall at exactly measured intervals and each suture was fastened to a recording lever. The tracings, however, simply confirmed what could already be seen. Normal contraction of the ureter extending from the kidney pelvis to the bladder could be observed regularly every 20 to 25 seconds.

In the severed ureter, peristaltic contraction was not impaired at the moment of operation, the intermittent wave of contraction being sufficiently vigorous to push a probe out of the lumen of the upper portion of the ureter. After 24 hours, however, the entire upper end of the ureter was found to be absolutely inert,

excitation awakening no contraction in this portion although a slight response could be evoked in the lower portion. On the fourth day, as seen in animal 20, slight peristalsis could be observed, the waves of which seemed to fade out before the line of suture was reached. On the eighth day, in animal 19, the central end was found inert but the peripheral end showed contraction upon suitable stimulation. Until the eighth day the mere section of the ureter brought about this result: paralysis of the central portion while peristalsis in the peripheral portion remained intact.

Further study of the end results shows that after the seventh week the ureter regains its motility in degree depending upon the condition of the anastomosis. Where stenosis of this junction occurred, as in animal 14 on the fifty seventh day, the upper end was found dilated and apparently inert. There was not complete paralysis, however, since feeble contractions could be seen passing over the suture line. The contractions were more frequent than in the normal ureter but for two or three contractions in the upper portion there was only one contraction in the lower end. The physiological union between the two extremities appeared to be absolutely interrupted by the cicatrix, an observation previously reported by Alskne. The central dilatation following ureteral stenosis would thus appear to be not so much a matter of paralysis as of atony by distention.

On the other hand, animal 15, sacrificed on the fifty fourth day, presented an apparently normal ureter in which frequent and vigorous peristaltic waves were clearly observed to pass from end to end across the line of suture. Similarly, the ureter in animal 13, sacrificed on the sixtieth day, showed perfect motility, spontaneous as well as provoked, with contraction waves passing from one end to the other. Again, in animal 2, in which section was made so close to the bladder that it was impossible to see the contraction of the lower end, upon sacrifice after 102 days the upper portion of the ureter was found not to be dilated but to have a perfectly strong and regular motor activity.

From the foregoing observations it seems certain that ureteral paralysis following sec-



tion affects only the central end. This paralysis disappears and motility returns after the first week if there has been no development of stenosis at the line of suture. Ureteral paralysis of itself has no effect on the kidney. The cause of the renal damage is in the secondary dilatation following stricture of the ureter and leading to an atony by distention. Furthermore, although one would hesitate to draw any definite conclusion concerning the influence of pyelostomy on ureteral repair, attention must be called to the fact that animals 13 and 15, in which after about 8 weeks practically normal ureters were found, had each undergone temporary pyelostomy.

The present investigation has shown that ureteral section does not necessitate nephrectomy as formerly claimed and that the development of stenosis is the most serious complication encountered in the repair of such injury. It would seem, therefore, that the avoidance of stenosis of the ureter should be a primary consideration and that diversion of the urine by pyelostomy and temporary obstruction is the operative procedure of choice in all attempts at repair of the ureter.

Nephrectomy is indicated without question, however, in cases in which the repair of ureteral injury will certainly be followed by infection. Pyonephrosis is especially dangerous early in the postoperative course. Hinman in this connection has shown both experimentally and clinically that renal atrophy is always preceded by distention, and cites among 17 cases of ureteral ligation followed by late nephrectomy 14 cases of hydronephrosis. In addition, in 64 cases found in the literature only 20 failed to show pain or a mass on the affected side. With such evidence it is not difficult to understand the increased spread of infection as atrophy develops.

Nephrectomy must not be done, however, unless the remaining kidney is found functionally competent to meet the added burden imposed upon it. If the condition of the remaining kidney is not known, pyelostomy with ureteral obstruction is to be done. This procedure, without any tentative repair or even ligation of the ureter, the dangers of which have been shown, prevents the flow of

urine over the injured area and secures urinary elimination while allowing the patient to recover sufficiently to undergo cystoscopy and ureteral catheterization. Should the opposite kidney be found sufficiently normal at this deferred examination, nephrectomy is performed to free the patient of her fistula. Should the opposite kidney be judged incapable of carrying on renal function alone, permanent ureterostomy should be performed, the severed ureter being brought directly to the skin, since pyelostomy is only a temporary procedure.

The question of the advisability of colic implantation as treatment of surgical section of the ureter is an unsettled one. In France such treatment has not found favor, but since the procedure of Coffey can conveniently be employed the danger of an ascending infection seems negligible. An interesting modification of this operation has been proposed by Mayo who has reported numerous cases dealing exclusively with the treatment of vesical atrophy. It is evident, however, that the injuries left in the pelvis by a difficult hysterectomy would cause most surgeons to hesitate in opening the intestinal tract.

The procedure here presented is simple, rapid, and requires no special instrumentation. While the ureter is being sutured and the abdominal wall closed, a series of bougies of appropriate sizes No. 12 and up, usually can be sterilized and pyelostomy immediately performed with little added shock to the patient. In place of a long and difficult procedure one has here a new and important operation of emergency.

The use of an indwelling ureteral sound through pyelostomy has been reported by McArthur in a case in which the ureter had suffered extensive traumatic loss of substance, the procedure being inspired by an analogous method of treating loss of substance of the common duct after operative injuries. Kramer in his recent experimental studies asserts that the obstruction of the ureter in such cases of urinary diversion is always the most important factor, for while drainage might appear dependent on a catheter in the renal pelvis, it is actually due to the fact that the ureter is obstructed by a solid bougie.

# CONCLUSION

The usual procedures of repairing a severed ureter generally lead to a more or less rapid degeneration of the kidney. As immediate nephrectomy cannot always be performed, there is need for a new operative technique. The essential part of such technique is the diversion of the urine during the period of ureteral repair, a period experimentally necessitating about 5 days. Urinary diversion is obtained by pyelostomy together with obstruction of the ureter by a bougie. As long as the bougie is in place there is continuous drainage. As soon as the bougie is withdrawn the urine takes its normal course and the fistula closes spontaneously.

The ureter should be repaired by end to end anastomosis with four everting sutures after removal of redundant mucous membrane along the ends to be brought together. The removal of mucosa obviates its eversion which would otherwise prevent primary healing.

Diversion of the urine permits cicatrization of the severed ureter without the development of stenosis just as cystostomy checks the formation of traumatic stricture of the urethra. By preventing ureteral stenosis this procedure removes the cause of dilatation, atony, and finally complete renal atrophy.

It is to be hoped that this method, experimentally suggestive of great possibilities, will be given the trial it deserves and its value confirmed by distinctly clinical data.

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## THE DEMONSTRATION OF A TRUE INTERNAL INGUINAL SPHINCTER AND ITS ETIOLOGIC RÔLE IN HERNIA

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**I**T is our purpose, in this preliminary article, to advance an original conception of the etiology of inguinal hernia and to substantiate that conception, in so far as possible, and throughout, to indicate its applicability in the treatment and cure of the comparatively common affection under discussion.

At the present time, the theories advanced in explanation of the etiology of inguinal hernia are many and demonstrate by their mere multiplicity the fact that the subject is far from settled. Thus, inguinal hernia has been attributed to such various conditions as constitutional diathesis, lengthened mesentery, increased intra abdominal pressure, and, especially lately, the presence of a congenitally preformed inguinal sac. That all of these factors, in selected instances, have a direct etiological relationship to inguinal hernia can not be doubted. However, it has long been our contention that the most important factor in the etiology of inguinal hernia is an insufficiency of sphincteric action on the part of the muscular ring at the internal opening of the inguinal canal, and that the factors mentioned above are only secondarily concerned in the final production of the peritoneal and visceral extrusion.

In outline, our thesis may be stated as follows:

Surrounding the spermatic cord at the internal abdominal ring is a muscular structure for which the name "inguinal sphincter" is entirely justified. The sphincter is voluntary in character and, indeed, possesses a distinct motor supply. Functionally, it protects the internal ring, first, by a normal state of tonus, and, second, by voluntary contraction whenever the intra abdominal tension is increased through abdominal muscular strain. When, however, the sphincter becomes, for any reason, relaxed or atrophic the internal opening of the inguinal canal is left sufficiently patent to accommodate an entering wedge of peritoneum, extruded by the variations in intra-

abdominal pressure. Sphincteric relaxation may be produced in a variety of ways, as, for instance:

1 Prolonged, exhaustive abdominal strain such as may be produced by a constant, tiring cough, hard labor in a stooping position, abdominal tumors, etc.

2 A sudden, severe increase in intra abdominal tension, which may either overcome the sphincter, or, literally, catch it off its guard.

3 Atrophy of the sphincter, induced by section of its motor nerve supply, such as may occur in the course of certain laparotomy incisions, notably the Davis and McBurney.

In any case, the entering wedge of peritoneum by dilating and inducing paresis of the inguinal sphincter, initiates a vicious circle which greatly favors the final production of the hernia.

The proof of this thesis is evidently difficult, in that most hernias are seen at so late a stage that all original sphincteric activity has been obliterated and may not be evident to the examiner or operator. Such evidence as is available, therefore, will lie along anatomical, empirical, and experimental lines and may be briefly anticipated as follows:

**A Anatomical proof.** Under this head, the anatomy of inguinal hernia will be considered, and the actual existence of a muscular sphincter at the internal inguinal os, demonstrated. Further, it will be shown that hernia is physiologically impossible as long as the normal tone of this sphincter is maintained.

**B Empirical proof.** In this section, it will be shown that the various secondary factors of heredity and constitutional diathesis can be scientifically correlated with our present conception, and that the older theory of congenital sacculary patency presents defects which render it untenable as a satisfactory explanation of the etiology of inguinal hernia.

**C Experimental proof.** This, to substantiate our premise, would naturally be directed along the following lines of investigation:

1 To demonstrate the presence of an internal inguinal sphincter in such laboratory animals as are available

2 To investigate the structure, function, and nerve supply of that sphincter

3 To determine the effect of experimental paresis, such as may be induced by section of the motor nerve supply to the sphincter muscle

Finally, to determine the applicability of all our findings to the treatment and operative cure of inguinal hernia

The evidence obtained by the lines of investigation outlined above will be presented and elaborated in the following sections

#### ANATOMICAL PROOF

The existence of a distinct sphincteric muscular ring at the internal opening of the inguinal canal, seems, heretofore, to have been nowhere recorded in the literature. Several observers, however, have recognized the "sphincter like" or "shutter like" action of the muscles of this region. Thus, Hammond (13), in describing the internal ring, writes as follows

Immediately above and in front, lie the curved muscular fibres of the internal oblique and transversalis, which, in contracting become opposed to Poupart's ligament and act as a sphincter to close the internal ring compression of the spermatic vessels being prevented by the downward convexity of Poupart's ligament

Darling (14) also described the superior portion of the sphincter as follows

In cases of deficiency of the conjoined tendon the 'inguinal sphincter' must be defective in action because the movable lower border of the transversalis cannot be approximated to the inguinal ligament

Again Cawell (3) described a vascular ring surrounding the internal opening of the canal and remarked upon the similarity of its architecture to that of vessels ordinarily supplying sphincteric musculature

As to why these observers stopped with only a partial description of an easily demonstrable structure, no explanation is forthcoming. In our series of dissections, and in the experimental work to be described later, not

only was a "sphincter like" action of the muscles demonstrable, but the actual existence of a well developed muscular sphincter at the internal ring was proved. The structure may easily be demonstrated by the following dissection

Expose the external ring by a 10 centimeter oblique incision through the skin and superficial fascia, in the direction of the lower pillar. Expose the cord and internal ring by reflecting the external oblique aponeurosis downward from an incision 4 centimeters above, and parallel to, Poupart's ligament. By appropriate dissection, it may now be demonstrated that the so called "arching fibers" at the attachment of the conjoined tendon around the ring, not only arch over the cord, but actually course completely around it, interposing themselves, below, between the cord and the inguinal ligament. In this manner, the contained muscular fibers form a complete and grossly definable sphincter for the canal at its abdominal opening. It is our contention that this sphincter is demonstrable in all normally developed individuals and that relaxation of its fibers is the primary factor in the causation of the great majority of inguinal hernias

#### EMPIRICAL CONSIDERATIONS

Under the heading "The Etiology of the Inguinal Hernia," most authors, after outlining the congenital sac theory, generally classify the currently accepted causes as either (1) predisposing or (2) exciting. We shall follow a similar plan but attempt to co ordinate these factors with our newer conception of the basic etiology. The classification may be given as follows

*Predisposing causes* 1 The congenital sac. The current theory of the etiology of inguinal hernia is based upon this structure and postulates that a hernia is produced by the invagination of peritoneum and abdominal contents into a patent, subinvolved processus vaginalis, e.g., that process of peritoneum which precedes the testicle in its descent into the scrotum. Of late however, investigation has uncovered evidence which is directly at variance with this theory. To begin with, Macready (9) observes that

If an unclosed canal were universally attended with rupture the number of ruptures would be very much greater than it is

Murray (5) considers that if the theory had any bearing at all, its applicability would be limited to infants, in which the sac is characteristically long, narrow, and distinctly constricted at its proximal end. In children and adults, however, the same author invariably found that the sac did not resemble the congenital tunica vaginalis but was always of a clearly differentiable acquired form and as constantly associated with atrophy of the muscles surrounding its abdominal opening. The sac in these instances, moreover, closely resembled that of a postoperative ventral hernia, in that it was a simple conical process of peritoneum evaginated through a relaxed abdominal, muscular os.

The support lent our theory by these findings is evidence, since the etiological relationship of the congenital sac to inguinal hernia, in adults at least, is thus proved to be the exception rather than the rule.

2 Heredity According to Eccles (14), 25 per cent of all persons suffering from hernia give a definite history of familial predisposition. Andrews found a large number of hernias in individuals who showed other congenital malformations. Moorehead states that

The family history of hernia is often surprising and points to some transmitted strain of muscular deficiency as typical as a facial feature or a birth mark.

—a deficiency, obviously, which would directly concern the inguinal sphincter. Morrison cites a case in point in which, out of an immediate family of 19 in three generations, 13 had inguinal hernia.

3 Nutrition The importance of the maintenance of muscular tone is illustrated by the 20 per cent increase in the incidence of inguinal hernia during the world war starvation period in Germany (15). Were the occurrence of hernia to depend on the mere presence of a congenitally preformed inguinal sac, no explanation for this marked periodic increase would be forthcoming.

4 Age The examination of a large number of cases tends to show that, after the first

year, in which hernia is most frequent (13 per cent), the incidence of hernia is greatest during the years in which life is most active. The importance of the activity factor is illustrated by our own experience with hernia during the world war. Recruits, called from sedentary occupations to relatively strenuous military service, developed a high incidence of hernia during the early period of training. In commenting on this point, Watson (15) remarks

If the muscles (i.e.—the internal inguinal sphincters) could withstand the strenuous unaccustomed exercise for the first few weeks the added resistance that comes from such training made the later appearance of hernia infrequent.

5 Occupation Statistically, hernia is most frequent in patients continuously subjected to severe abdominal strain, especially in the stooping position. Thus, stokers, coal heavers, plate layers, gardeners, etc., seem to be peculiarly liable. It is difficult to see how this occupational incidence can be explained by "the increased frequency of the presence of congenital sacs." The fact, however, directly supports our theory. Stooping causes the inguinal sphincter to function at a distinct disadvantage,—while strain during this position causes a marked increase in intra-abdominal pressure. It is therefore, quite conceivable that sudden and repeated strains, under these circumstances, will cause the extrusion of a gradually enlarging peritoneal cone through the internal ring and into the inguinal canal. The process is then accelerated by the accompanying pressure paresis of the inguinal sphincter.

Of equal significance is the comparatively high incidence of double hernias in these instances (15).

6 Hernial diathesis Eccles observed a peculiar "triple bulging" of the abdomen in subjects with a predisposition to inguinal hernia, in which the abdominal muscles, where not bound down by fascial attachments formed three circumscribed ventral protruberances. A related type has been described as associated with prolapse of the mesentery in which the upper part of the abdomen is flat, while the lower is lax and protuberant. According to our conception, however, both the bulging

and the hernial diathesis are adequately explained by the generalized weakness of the abdominal musculature and the consequent insufficiency of the internal inguinal sphincter

7 Lipoma in the inguinal canal This factor was given prominence by Speed, who in 154 hernia operations, found lipomata in 47.4 per cent Another generally accepted cause of hernia is the presence of an undescended testicle in the inguinal canal We believe, however, that both of these factors act through the constant dilatation and consequent weakening of the internal sphincter and thus indirectly produce the subsequent invitation to hernial protrusion

8 Hernia following appendectomy wounds This, according to Watson, is more common than is generally supposed being especially frequent following the McBurney incision The explanation is again evident, since the muscle splitting is directly in the course of the motor nerves to the muscles of the internal ring Section of these nerves, with consequent degeneration of the sphincter, would, in our conception, adequately account for the undoubtedly high incidence of these hernias

*The exciting causes* Under this head most authors list such "directly" productive causes as pregnancy, parturition, chronic cough, ascites, abdominal tumors, tight lacing etc It is evident that the common factor in all of them is a constantly high intra abdominal pressure We believe, however, that such causes can act only indirectly, either by causing sphincteric weakness, or by inducing hernial protrusions at such moments when the sphincter happens to relax A comment in point is made by Murray, who observes,

In a person with a perfectly formed abdominal wall I believe it to be impossible for a hernia to occur

It is evident therefore, that clinical experience is in accord with our theory of the sphincter atonic causation of inguinal hernia, and in fact, is explained most satisfactorily by such a conception

#### EXPERIMENTAL PROOF

The above review of the literature gave the author ground for the belief that animal ex-

perimentation would, quite probably, throw further light on the subject In this preliminary paper, the report of one such experiment will be submitted, with the full understanding that further laboratory and operative investigation is essential before final conclusions can be reached

*The method* A large dog was etherized, and its lower abdominal region, thighs, and genitals were shaved and prepared Aseptic and antiseptic precautions were observed throughout the experiment

On the right side, an incision through skin and fascia was made one inch above, and parallel to, the inguinal ligament The internal ring was next exposed, in a manner similar to that employed in the human by dividing and retracting the external oblique along the course of the spermatic cord The inguinal sphincter in the dog operated on was found to be a well defined, ring shaped body of muscle fitting snugly around the cord where the latter dropped into the abdominal cavity through the origins of the internal oblique and transversalis muscles The spermatic cord was then doubly ligated and cut about two inches from the abdominal ring, in order to obviate the action of the cremaster The end of the proximal ligature was left long for use as a retractor

Attention was now devoted to the inguinal sphincter Minimal stimulation with the electrodes of an induction coil produced well defined circular contractions of the cord It was significant that the circular contractions involved the entire sphincter and were produced, in equal degree, indifferently as to which portion of the sphincteric ring was stimulated The constriction of the cord was sufficient to diminish markedly the bleeding from a cut in the spermatic artery and firmly to fix a probe inserted through the sphincter alongside the vas Significantly also, at no point of stimulation anywhere in the inguinal region could an only partial constriction of the sphincter be obtained, as had been described in the human, for the "sphincter like" action of the superior arching fibers of the transversalis and internal oblique As is true of sphincters in general, the internal ring either contracted *in toto* or not at all

By careful dissection, the sphincter was removed, slipped over the cut end of the cord, and preserved in formalin for serial section. The muscles were then secured by buried cat-gut sutures and the skin wound was approximated by silver wire.

On the left side, a different procedure was followed. It was our purpose here to isolate the nerve supply to the inguinal sphincter, determine its identity, and by neurosection, attempt to produce a definite atrophy of the sphincteric ring. Accordingly, a rather long (8 centimeters) oblique incision was made directly through skin, fascia, and external oblique, the former two structures retracted, and the latter widely separated by blunt dissection. The iliohypogastric and ilio inguinal nerves were then isolated in the fascial plane between the external and internal oblique muscles, and the motor distribution of the branches of each determined by minimal stimulation with the electrodes of the induction coil. By this means, a small branch of the inguinal division of the ilio inguinal, running inferomedially to the region of the internal abdominal ring, was isolated. Stimulation of this branch invariably produced a circular constriction of the inguinal sphincter, as surely as had direct stimulation of that structure.

After proper identification, a small section was removed from the nerve and the wound closed in a manner similar to that employed on the opposite side. A sufficient time (8 days) was allowed to elapse for the degeneration of the sphincter, during which interval the dog was kept in as good condition as possible. At the expiration of this period, the left incision was reopened. The inguinal sphincter was then found to be relaxed to such an extent that the cord merely dropped into the abdomen through an opening 2.5 centimeters in diameter, whereas the surrounding muscles were uninvolved. The dilated left sphincter was then dissected out and also removed for serial section.

*Results of the experiment.* The reasons for, and the significance of, the various parts of the experiment have already been indicated in the description given above. Primarily, our investigation indicated that, in the dog at least,

an inguinal sphincter, distinct in structure and nerve supply, existed. Further, the procedure showed that the sphincter acted as a physiological unit and functioned, when stimulated, to close the internal opening of the inguinal canal.

Careful study was subsequently made of serial sections obtained from the normal (right) inguinal sphincter. The microscope revealed the presence of skeletal muscle only, smooth muscle fibers being absent from all of the sections. Apparently, then, the inguinal sphincter resembles the outer sphincter of the anus in that both are entirely voluntary.

The serial sections obtained from the degenerated (left) inguinal sphincter were submitted to Dr. Davis, head of our pathology department. His diagnosis confirmed our conclusions, in that again smooth muscle was reported absent, whereas the skeletal muscle and nerve tissue present in the sections showed a type of degeneration typical of that following motor nerve resection.

#### CONCLUSIONS

The work already done, while not extensive, nevertheless indicates the importance of the following conclusions:

1. Clinically, the sphincter atonic theory of the causation of inguinal hernia satisfactorily explains the etiology of the greatest number of cases, irrespective of the presence of a congenital sac or such other minor factors.

2. Anatomically, the existence of the sphincter can be demonstrated either by dissection or during operation.

3. Experimentally, it can be shown that this sphincter, both by structure and function, protects the internal opening of the inguinal canal, and that section of its distinct nerve supply can and does produce atrophic dilatation of the internal abdominal ring.

4. Finally, that the importance of the internal inguinal sphincter in the etiology and management of inguinal hernia has in the past, not been sufficiently appreciated.

In subsequent papers, we shall extend the report of our experimental work and discuss the relation of the inguinal sphincter to the treatment and operative management of inguinal hernia.

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THE SURGEON, THE PATIENT, AND THE CLINICAL DIAGNOSIS<sup>1</sup>

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TECHNIQUE commands almost the undivided attention of the younger surgeons. It has been said that as the bride in Milton's *Comus* was arrayed in chastity so the modern surgeon is arrayed in purity, hence, postoperative infections have well nigh disappeared.

The relative safety of operations, the dramatic features of a surgical procedure, the profound impression such a procedure has upon the patient's family and a portion of the community, and perhaps a lurking thought now and then among a few of a handsome fee, are luring younger surgeons into the exclusive path of technique.

In this age, technique and the laboratory are twins, dominant and insistent, and not unusually insolent. The bedside diagnostician must usually wait for the laboratory report and a favored diagnostic method without the laboratory study is surgical exploration. One who explores habitually is like Mr Micawber seeking wealth and in momentary expectation of something turning up. Often, of course, exploration is demanded.

All emergencies are in the imperative mood and the present tense. To delay in order to obtain reports of the roentgenologist, who may not be accessible until some hour of the next day, of the hematologist and the bacteriologist, who may be on a journey, perhaps will mean an unnecessary fatality. I believe thoroughly in having proper laboratory studies made and by proper I mean when there is necessity and when there is time for them. It is true that at times a certainly accurate diagnosis, that is to say a diagnosis as to details may be impossible without exploration or laboratory aids. It is possible, for instance, to diagnose dislocations, most fractures, cerebral compression, and many other conditions without laboratory or X ray help. It is very difficult today to force the younger hospital surgeons to submit a diagnosis in a fracture until they have X ray pictures. In the abdomen it may be quite impossible for the

surgeon to be certain as to the exact nature of the lesion but he can be certain if there is an acute abdominal calamity. Again the X ray is not always certain. This is the case in some fractures of the vertebrae, in some cases of gall stones, in stone in the ureter (which may be confused with a phlebolith or a calcified gland), in brain tumor (which in some doubtful cases excites a suspicion of a mental thunderstorm), and various other conditions. Nor is exploratory incision always a certain revealer of the truth. Its value depends largely on the experienced mind and the trained fingers of the operator. An inexperienced man may find nothing. Even an experienced man may at times be disappointed and find nothing to explain the situation.

The late Prof. J. Greig Smith, of University College Bristol, said many wise things, among them the following:

"There is no doubt that a good deal of rashness and a certain amount of incompetence is sought to be concealed by the practice of exploratory incision. No incision ought to be simply exploratory and at the utmost it ought to be ultimately diagnostic in a case of extreme doubt and difficulty. The exploratory incision of the skilled surgeon is extremely different from that of the tyro. Where the former may make a correct diagnosis in 99 out of 100 cases the latter will fail over his tenth case, but he may not conclude that the justification of exploration is assured simply because he is in doubt in this case. Perhaps surgeons of large experience are somewhat to blame for so freely speaking of this tentative procedure as being frequently justifiable and necessary. What is justifiable in their experienced hands may not be so in the hands of the less experienced men. Before submitting our patient to what after all is a serious operation and a trying illness we ought again and again to return to the examination of the disease, read and re-read the exhaustive history and decide only after having done this. At different examinations the

<sup>1</sup>A number of years ago I presented a paper on this topic which was published in the *Transactions of the American Medical Association*. The two articles are similar but not identical. In this paper I quote to myself at times. Such quotation may mean scantiness of mental resources but it may also be due to profound conviction. If one believes he must preach and repeat. The great Carlyle did so often surely an insect may. J. C. D'Ac.

mind focuses its attention on different points and in different directions and each examination may give us new information."

It is true that at times a complete and accurate diagnosis is impossible without an exploratory incision, but even in such a case a diagnosis can be made of an acute condition requiring immediate operation or of a chronic lesion requiring exploration for complete elucidation and treatment. The diagnosis is of course, in every case the foundation of prognosis and treatment.

In striving to identify the condition, the surgeon should grasp all the physiological deviations and endeavor to visualize the anatomy of the region, the situation and extent of the lesion, and the picture of the pathological process. The surgeon himself must do this. The investigation is not to be delegated. The moral responsibility is on the surgeon in charge and he must not be lazy or carelessly indifferent to his responsibility and must not shrink from it because of fear or try to evade it because of doubt of himself. If he doubts himself he has chosen the wrong calling in life. To operate simply and only because a pathologist recommends it or a colleague advises it is an evasion of personal surgical responsibility due to laziness, indifference, ignorance, or moral cowardice. All recommendations from consultants and all laboratory reports must be studied and judged by the surgeon without a trace of prejudice. Such a grave personal responsibility cannot be laid upon the shoulders of another no matter how broad those shoulders may be. Needless hesitation and delay in rendering a decision as to the diagnosis and treatment is abandonment of duty by the general when the battle has begun. His decision should be prompt and final. He may be in entire agreement with the consultant but he should never go solely upon the opinion of any other person, however prominent or persuasive that person may be.

The surgeon must see to it that his own shoulders bear the burden, for a surgeon's shoulders by study and experience, in the words of the late Professor Joseph Pancoast, must become broad enough to bear the bur-

den. This is a peremptory mandate and in it is a proof of the dignity of our calling. If one cannot or will not assume the full responsibility cast upon him by the personal trust of the patient, he belongs in some other calling and the trials and triumphs of the surgeon are not for him.

Of course, I do not mean that the surgeon should disregard the opinions of consultants. He should give such opinions full and respectful attention particularly if they do not agree with his own opinions. In every case when necessary and when there is time to obtain them, the reports from the chemical, pathological, and X-ray laboratories must be obtained, and these, with the opinion of consultations, will be studied and weighed before the final decision, which is and must be made by the surgeon in charge. A consultation is a great comfort and a decided support and it often furnishes extremely valuable suggestions. Responsibility is lessened when a colleague shares it. A family is soothed by a consultation and, should things go wrong, the acerbity of criticism is blunted. A surgical consultation resembles a council of war, but the surgeon may do as General Grant did after a council of war, proceed in accordance with his own opinions and against the advice of his consultants. In doing such a thing, however, remember Davy Crockett's words, "Be sure you are right and *then* go ahead."

A very young surgeon, laboring under mental growing pains, may oppose or actually resent a request for a consultation, believing that a family desire for one is an implied criticism of him or that a suggestion from him for a consultation would be regarded by the family as a confession of incompetence. A very ignorant man is apt to oppose a consultation because he fears exposure before a wise and learned man. Such a coward, it is true guards himself but he does so by sacrificing his patient. A man dominated by vanity and obsessed by the conviction of his infallibility is sure to be contemptuous of the views of others and is certain to sacrifice patients to his obsessions and contempt. Such a man will not hear of a consultation. The more profound the knowledge and the greater the experience of a surgeon the stronger will

<sup>1</sup>Abdominal Surgery by Prof. J. Greig Smith.

be his conviction that often the best of men make mistakes and the gladder he will be to have a consultation. To insist on being the one to assume the responsibility and issue the final decision as to the diagnosis and treatment will at times bring embarrassing experiences. The surgeon may be obliged to disagree entirely with the attending physician as to the diagnosis, the treatment, or both. He may have traveled many miles expecting to operate and yet be obliged to decline to use the knife. Such a course may make medical enemies and lessen the number of referred cases, but it diminishes needless operations and saves lives. A surgeon should go to a case without any preconceived belief as to what the condition is. Preconception prejudice, predominant ideas may prove fatal to accurate observation and reasoning because the mind is all too apt to put the condition on the bed of Procrustes and stretch it to fit the ideas. It is all too easy to see the things we want to see or fear particularly to see. In order to make a diagnosis it is not enough to obtain from the patient one or two symptoms. The study should be complete. There should be a mental picture of the disease, a picture made up of the essential elements belonging to it. A clinical picture may be complete, it may lack one or two of the usual features or one or two elements may be exaggerated into seeming caricatures. The picture may be confused or blurred or something may be present which doesn't seem to belong there. Occasionally the picture consists only of a dim outline of a group of shadows.

Even the venest tyro should comprehend those unusual cases in which the picture is complete. An exaggerated, blurred, or shadowy picture can be interpreted by no one but an expert and perhaps not by him. In not a few cases a positive diagnosis can be reached only by exploratory incision, by X-ray studies, by therapeutic tests, or by laboratory aids.

We have just pointed out that even an exploratory incision does not invariably make the diagnosis clear. Nevertheless, whereas comprehensive mathematical certainty as to the study of the entire organism is not possible, in most cases it is possible to make a

correct diagnosis. It is seldom that a symptom could have but one possible cause, hence every possible cause of such a symptom must be thought of and sought for. Elevated temperature may be due to bacterial infection, auto-intoxication, hyperthyroidism, gout, uræmia, leukæmia, poisoning by illuminating gas or belladonna, sunstroke, malignant disease, Hodgkin's disease, syphilis or absorption of aseptic pyrogenous material from an area of traumatism, injury of the brain or cervical cord, iodoform poisoning or other things. As a solitary symptom, elevated temperature does not suffice for a diagnosis. The mode of onset, the conduct, the course, and the associations of the fever may be conclusive. In doubtful surgical cases, the rectal temperature is the only one upon which reliance is to be placed. In many cases of severe peritonitis, the axillary temperature may be found normal or subnormal and the rectal temperature much elevated. The wider the difference between these two records the worse the situation.

A question always to be asked is this: Did the disease begin with chilly sensations, a chill, or chills? Did a chill or chills arise without other symptoms? Were chills slight or severe, regular or irregular, and were they followed by sweats? In a multitude of diseases pain is a striking symptom. It is necessary to know its exact situation and if it has shifted from one region to another, if it developed with or as an addition to pain in another region. Its character (is it aching, lancinating, pulsating, shooting, or dull), if it came on suddenly or gradually, if it was at first trivial and became progressively worse. We ask if it is intense or moderate. Is it continuous and steady, continuous with exacerbations or remissions, or is it intermittent? Is its position fixed or shifting? Does it follow a nerve trajectory? Does it arise only on motion or pressure or is it present even when at rest? Is it accompanied by tenderness or rigidity? Is there nausea and does vomiting take place? Is the temperature elevated? Is the pulse accelerated and what is its character? In determining the exact situation of pain, have the patient place his hand or a finger upon the spot so as to avoid a mistake.

Make every effort to determine which organ, viscus, or structure is the seat of pain. The sudden cessation of violent pain, if not obtained by opiates, may mean the relief of a pathological condition, for instance, the release of strangulated hernia or a twist of the sigmoid, but it may be a most ominous sign, significant of gangrene, as in certain cases of appendicitis or intestinal obstruction.

In estimating the reality, persistence, and intensity of pain, study the face. For instance, in acute peritonitis, the face is set and contorted. The upper lip is raised, exposing some of the teeth. There is an expression of the greatest anxiety, the tips of the ears, the lips, and even the rest of the face may be cyanosed. Fothergill pointed out that in pain, not due to peritonitis, there is a marked twitching of the muscles about the eyes and the upper lip. When a person has been a long sufferer from pain there is a heaviness and fullness about the eyes, the brows are contracted, the angles of the mouth droop and the expression is utterly weary and hopeless. The expression of the face in children is extremely important. Professor Hobart A. Hare<sup>1</sup> says "It is not uncommon for an expression to pass over the face of a child while sleeping when suffering from pain which begins with a smile and ends with a drawing in of the corners of the mouth, an expression somewhat like that seen on the face of a waking child when it seems to be in doubt as to whether to laugh or cry. Whether asleep or awake a child in pain, if not crying, has a pinched look about its nose and mouth and sometimes some idea of the seat of pain may be gained by the part of the face which is drawn. When pain is in the head, the forehead is apt to be wrinkled into a frown; if the nose is pinched and drawn, it is said to show that the pain is in the chest, and if the upper lip is raised, the pain is probably felt in the belly."

The face, of course, may indicate many things besides pain, for instance, alcoholism, the opium habit, tetanus, strychnine poisoning, *le doloureux*, jaundice (the white of the eye and skin being yellow), anemia, cachexia of cancer, hyperthyroidism, hypothyroid

ism, menstruation, œdema, Bright's disease, mouth breathing from adenoids, acromegaly, paralysis of the facial nerve, etc. In shock, there is deadly pallor, in most cases of advancing peritonitis, cyanosis—in poisoning by coal tar products, cyanosis—in exhausting diseases, pallor and emaciation. Cancer imparts a straw yellow color to the skin, contrasting with the pearly white conjunctivæ. This contrast at once indicates the diagnosis from jaundice. In lobar pneumonia the face is flushed and the flush is usually accentuated on one cheek. In cardiac disease there may be pallor or cyanosis with distended nostrils and gasping respiration. In advanced sepsis the dull and apathetic face is ashy pale or dusky, the lips mutter in delirium, and the teeth are covered with sordes. Bodily weakness, marked loss of flesh, rapid pulse, polyuria, hæmaturia, disorder of the reflexes, diarrhœa, spitting of blood, cough, malæna, constipation, ascites, indigestion, nausea, vomiting, headache, motor paralysis, anal gesia, hæmorrhoids, may be due to various causes.

The mode of onset, character, severity, duration of the disease, and the apparent cause help us to mark the significance of any of the above symptoms.

An isolated symptom is very seldom as valuable diagnostically as a symptom group. Pathognomonic symptoms are extremely unusual. The disease may fail to exhibit some symptoms regarded as belonging to it. Such an absence constitutes a negative symptom.

A victim of brain tumor may not have choking of the optic discs (for instance in glioma, in slow growing tumor, and, for a considerable time, in tumor of the pituitary gland). A patient with cancer of the stomach may have no pain. An individual laboring under pyogenic infection may have no elevation of temperature and a man with peritonitis may have a slow pulse. Leucocytosis may be absent when pus is present (if the defenses of the system are failing or if the pus is encompassed by adhesions). A negative Wassermann reaction is not uncommon in tertiary syphilis and a positive reaction may only be developed after the inauguration of specific treatment. In appendicitis, if the

<sup>1</sup>Symptoms in the Diagnosis of Diseases.

appendix is in the pelvis there may be for a time no abdominal tenderness or rigidity. Abdominal rigidity may be absent if the appendix is tucked up back of or outside of the cæcum, a condition the late Dr Joseph Price compared to a dog with his tail between his legs. Rigidity will be absent in appendicitis if the belly is much relaxed from repeated pregnancies, if considerable morphia has been given, and perhaps if an ice bag has been employed.

Hare points out that valvular heart disease may produce no symptoms until the circulation is failing and that in a lung that is engorged there may be no rales. A negative symptom is often very important and may suggest failure of physiological reaction, acquired immunity, a complication, the previous administration of a drug, or the simultaneous existence of another disease.

Grave myocardial failure may cause the disappearance of heart murmurs. Morphine may arrest pain. The ice bag lessens abdominal inflammatory pain. Gangrene halts pain. Sometimes a clinical picture contains more than seems to belong to it and perhaps something thought to belong to a different disease. Such a condition is due to a complication, a predisposition, a drug habit, the previous administration of a drug by a physician or the simultaneous existence of another disease. When an inflamed appendix is adherent to the ureter, there may be hæmaturia and pain like that of renal colic, although of course, hæmaturia in a case of appendicitis may be due purely to nephritis. In the first form of hæmaturia, the blood comes from only one ureter, in the second form it comes from both. Such determination can be made only by means of the cystoscope. A patient who has been anesthetized by ether or chloroform but particularly by chloroform, may develop jaundice or acid intoxication. Abdominal operation even when carried out in a region well away from the stomach may be followed by vomiting of blood. When a man with piles develops intestinal obstruction, we know that the obstruction is not due to the piles but is due to some lesion, probably cancer, higher up in the intestinal canal. Obstinate insomnia during

the course of a disease or an injury, if not due to pain or a psychoneurosis demands an inquiry as to whether the patient is an alcoholic, or a habitue of morphia or heroin who has been deprived of his usual doses. Some persons are so strongly predisposed to delirium that it arises from very trivial elevations of temperature. Delirium from slight fever is common in children and in the aged.

Just as certain persons resemble each other, so may certain diseases. Typhoid fever with severe abdominal pain may resemble acute appendicitis. Chronic appendicitis, duodenal ulcer, gall bladder disease, gastric ulcer, chronic pancreatitis may resemble each other. Acute hæmorrhagic pancreatitis has been mistaken for intestinal obstruction, although the horrible pain of the former condition, as pointed out by Lord Moynihan, should prevent the mistake. The resemblance may be a mere suggestion of a likeness. It may be first more definite but on investigation will be found to lack certain features. The resemblance may be very strong in fact, it may be so close as to lead to the gravest diagnostic uncertainty. A disease unfortunately without any usual resemblance to another disease may take on such a resemblance for a brief time. Pleural pneumonia does not usually bear any resemblance to acute appendicitis, but pleural pneumonia of the right lower lobe may be thought for a time in the beginning to be appendicitis because of the abdominal pain, tenderness, and rigidity which may occur for a time in pneumonia and may lead to a diagnosis being made of acute appendicitis.

Sometimes a disease acts like an ingenious criminal and disguises itself so as to imitate another disease or at least so as to escape recognition entirely. Just as a person may have a different appearance at different times, so may a disease at different times and also in different persons. Unfortunately, there is no Bertillon system of measurements and there are no finger prints to aid us in recognizing disease. Nevertheless, despite complications, disguises, and resemblances, it is usually possible to identify the nature and seat of the disease.

Sometimes a doubtful diagnosis may be cleared up by the state of the consciousness, the occurrence of fits and their character, the posture of the patient in bed, or his gait while walking. Even the odor of the breath may help.

Failure in diagnosis makes symptomatic treatment the only resource and symptomatic treatment is haphazard, indefinite, and frequently hazardous. In fever from an infection, what good could possibly come from lowering the temperature with antipyretic drugs? Who can deny that fever is beneficial by destroying the bacteria or toxins? By lowering temperature great harm may be done. It is as true of sepsis as it is of scarlet fever that the most dangerous cases are those with a low temperature.

A correct diagnosis is essential for correct treatment. Diagnosis is in part a science and in part an art. As science it employs all known facts and accepted principles in the solution of a problem. It is in part an art because the surgeon must know how to observe, how to examine, how to utilize facts and how to employ principles. Diagnosis possesses enormous interest and is of vital importance. It is the greatest and most serious of all games, a game in which limb or life is frequently the stake. Its problems absorb the trained seeker for surgical truth as the problems of an obscure crime absorb the trained criminal investigator. On the proper solution of the puzzle the future or even the life of the patient may depend. Diagnosis is no job for a dull, callous, or lazy man.

In the making of a diagnosis the history must be developed and all morbid phenomena must be observed with accuracy. The history includes the history of the family, of the person and of the disease. Heredity may be of interest and importance—as in developmental defects, suspected syphilis of early life, neoplasms, tuberculous disease, hemophilia, hereditary telangiectasis, mental disease, spontaneous fractures, etc. The personal history is of extreme importance. Is there a history of syphilis, tuberculosis, cancer, antecedent febrile trouble, etc.? What are the habits of the patient as to drugs, to

bacco, alcohol, etc.? In what way did the disease begin and where did it seem to be located? What were the symptoms and what has been its course? To what does the patient attribute the condition? Is it continuous, remittent, or intermittent? Is it getting better or worse? What has been done for it and by whom? The latter is decidedly an important query. It is wise to check up on the patient's statements by obtaining a statement, if possible, from the family physician, but if that is impossible from a member of the family or a friend. In a young child our only source of information is the physician, a nurse, or a member of the family. If the patient is mentally affected, we must rely for his history on others rather than on himself.

The occupation of the patient may be the key to the diagnosis. For instance, in the keratoses of a radiologist, housemaid's knee, miner's elbow, arsenic workers' neuritis, phosphorous workers' necrosis, painter's paralysis, chauffeur's fracture, mercury workers' salivation, anthrax as seen in the wool sorter, the worker in hides or the junk dealer, the chrome sores of leather workers, etc. Even his sport should be considered. For instance, in the buttock bursa of the rower, lawn tennis arm, rider's knee, etc.

If a surgeon would question a patient well he must use as much skill as a lawyer requires to question a witness. Truths may have to be fished from floods of loquacity or dragged from depths of taciturnity. To listen for a moment or two when a patient is being questioned will enable us to determine not only the caliber and equipment of the patient, but also of the questioner. Haphazard questions are useless and often harmful. Questioning must be purposive, systematic, and logical. Repetitions are needless and often irritating to the patient. Sometimes it is well to be alone with the patient and to be very tactful when asking certain questions, for instance, as to a drug habit, masturbation, sexual perversion, alcoholism, or venereal disease. A sudden fool question stupidly propounded may result in violent rage, sullen silence, evasion, or a lie. One should not ask a clergyman when he last had gonorrhœa, or an

unmarried girl how long since she has been pregnant. The clergyman may be guilty and the girl unfortunate but a gentler examination would have been more apt to have elicited truth. Lies are common. As Prince Hal says "Some lies are as gross as mountains, open, palpable," but even the ablest diagnostician may be deceived by lies.

A paranoiac, a melancholiac, a paretic, or a victim of cerebral syphilis may make absurd statements, varying them and altering them under questioning. Such fabrications are delusional. A man who has had a head injury perhaps long before may be deliberately untruthful or he may exaggerate unconsciously, *mistaking his imaginings for realities*, as in Korsakoff's psychosis. At times lies are difficult to detect and at times detection is impossible. Litigants often lie, so do the victims of venereal disease, so do pregnant girls, so do masturbators, so do menstruating women and women going through the menopause. Hysterical women, opium eaters, cocaine users, heroin addicts, alcoholic inebriates, and epileptics lie freely and often needlessly. Habitual criminals are habitual liars and even in illness are prone to exaggerate and pervert. Some lies are prompted by the wish to become important or by the desire for sympathy. For instance those of hysterical women who lie from an egotism which leads to the assumption of a leading heroic or a martyr's role. A not uncommon cause of falsehood, particularly among women, is the desire to worry or injure a person. A man pretended desperate sickness in order to punish a wife for nagging him. Another man pretended to have received an internal injury in order to provoke the censure of a hated foreman. Children are apt to tell the most amazing untruths. An old man's statements are often unreliable particularly because his memory for recent events may be much confused. I would hardly go so far as Falstaff who said "Old men are addicted to this vice of lying." Hypochondriacs invent diseases and morbidly magnify real phenomena. The hysterical patient imitates unconsciously and so deceives. The boaster lies about his condition and his case in expectation of receiving a reputation for fortitude and

heroism. A man who fell down when drunk claimed to have been injured rescuing a child from in front of an automobile and had the police searching for the child and the car. Neurotics are very apt to make false statements. They may misinterpret real sensations or invent pains and disabilities. A child may lie to avoid school or punishment and many persons lie to avoid work, domestic discord, jury duty, in order to get in a hospital to collect accident or disability insurance or to obtain money by a suit at law. The trained army surgeon and the experienced naval surgeon are always on the watch for shirkers and become remarkably skillful in detecting them. Some patients lie to avoid a subpoena in a court case or to cover up drunkenness. Sometimes the family lies. They may do so in an injury involving litigation. They are almost certain to do so to cover up domestic trouble. They will usually do so in regard to epilepsy and mental disease. The supposed disgrace of insanity and epilepsy leads to absurd or shadowy claims of causal head injury in the far past. A statement which is part a lie is even more confusing than a complete lie.

"A lie which is all a lie may be met and fought with outright

But a lie which is part a truth is a harder matter to fight"

Observation, accurate and complete, is imperative. This requires a master's knowledge of disease and injuries, interest in the problem, close observation, knowing how to observe and question, and the ability to obtain clear registrations upon the memory. Accurate notes must be taken down at the time of the examination.

In Sterne's *Tristram Shandy* we find set forth a threefold cause for "obscurity and confusion" in a man's mind. "Dull organs, dear sir, in the first place. Secondly, a slight and transient impression made by the object and the said organs are dull, and thirdly, a memory like unto a sieve not able to retain what it has received." Dull organs in a patient or a doctor constitute formidable obstacles. "Against stupidity even the gods fight in vain."

Bedside notes constitute a record which is a lasting memory and may be most important in the scientific and at times in the medico-legal aspect of the case

Some men have an aptitude for the art of observation. Some have not. But no man is an accurate observer by instinct. He can become an accurate observer only by long training. Maudsley, in his brilliant and learned *Pathology of Mind*, says "True observation comes not by instinct but is gained painfully by training."

A person with an aptitude for observation can train the power more quickly and to a higher degree than can one whose observation reactions are dull. One observes most easily and accurately those things in which he is interested and which he knows best. Suppose a group of persons were thrown together by accident. Each one studies the other. The shoemaker at once notices the shoes, the tailor the clothes, the barber the hair, the dentist the teeth, and the hatter the hats. "Lazarus has rightly called to mind what is told by the pious Charles von Schmidt concerning the clever boy who lies under a tree and recognizes the condition of every passer by according to what he says, which means what he sees. 'What fine lumber,' 'Good morning, carpenter,' 'What magnificent bark,' 'Good morning, tanner,' 'What beautiful branches,' 'Good morning painter.'" (See *Criminal Psychology* by Hans Gross.) This significant story shows how effective is observation.

A competent specialist will at once observe phenomena which are in his line, which a general practitioner or a specialist in another line may not note at all.

Few men are universal observers as was Joseph Bell, of Edinburgh. Because a man observes quickly things relating to his own calling is no sign that he will be adept in observing things relating to other callings.

A woman is greatly interested in dress and a glance of but a moment enables her to describe accurately every visible garment worn by another woman, and yet she may not be able to describe intelligently anything else in life. A woman will give a description of the guests at a wedding and of the dress

each one wore so comprehensively and detailed as to seem uncanny but then a woman's real profession is matrimony and dress is a powerful aid to matrimony, hence her interest in dress and her success in describing it.

A person not interested in diagnosis is certain to be a poor diagnostician. Many persons are devoid absolutely of the power of correct observation. They go through life seeing nothing fully, accurately, or in detail, they know things only by their salient features and many things they do not really see at all. Such a person is a very unreliable witness in court, is often sure that what did not happen did happen and uncertain as to what he did see. He would make a better clerk than he would a surgeon.

Many sensations are never registered or rather are faintly registered and do not become impressions in the brain. Slight impressions do not give rise to ideas and cannot be recalled as memories. We have really observed when impressions have been registered and have given rise to ideas.

During a long period a person may fail really to see things with which he is in daily contact. Edridge Green in his treatise on *Memory* gives an example of such failure. He passed to his students the leaf of a tree. Not one could identify it. It was the leaf of the common plane tree of the streets of London. Every student had passed plane trees hundreds of times but no student had truly observed them.

The surgeon must carefully train and cultivate the power of observation. In most men the power may be greatly enhanced by constant exercise. Robert Houdin, the famous French prestidigitateur, is an example of one who trained his powers of observation so highly that they came to constitute a faculty which acted with marvelous speed and precision. While walking in the street he could after a simple passing glance into a show window, name and describe nearly everything exposed there for sale. In this we see a wonderful combination of close attention, rapid observation, vivid registration, and faultless memory.

Few men can become Houdins but almost any man, unless absolutely stupid, utterly



careless, or extremely lazy, may become a reasonably good observer. Every good diagnostician is a careful observer though some are better than others. A really good clinician sees at a glance the obvious things that a lesser man descries only after prolonged study or perhaps does not discover at all. A considerable part of the education of a child should be the development of the powers of observation. Children are natural observers but with the general idiocy which characterizes so many of the proceedings of modern life we carefully strive to take out of them this valuable faculty. In modern education observation should occupy a great place, even if so placing it makes necessary the sacrifice of the teaching of many facts and of some of the narrow specialties.

Our great aims should be how to observe, how to visualize the disease and its seat, how to study, what to study, and how to think. Most children visualize naturally. Tell them a story and they see the gnomes and the giants, the fairies and the goblins. We are doing our best to take this great faculty out of them.

The real method of observation was set forth by Huxley in 1880. He called it the method of Zadig. Zadig was Voltaire's philosopher who observed many apparently trivial things and from such indications reached conclusions so striking and unexpected as to cause his hearers to attribute them to supernatural influence or to roguery.

In modern literature we find a similar method employed by Edgar Allen Poe's *Dupin* and by Sir Arthur Conan Doyle's *Sherlock Holmes*. Those who read Dumas will remember how D'Artagnan searched the field in which the duel had been fought and from a series of small indications gave to the king a description of exactly what happened there.

If one observes inaccurately or incompletely he will never make a correct diagnosis unless he blunders on it or makes a successful guess.

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ing." A so called diagnosis by intuition is simply a jump to a conclusion after observing a symptom or a symptom group. It is seldom correct, and I pointed out years ago that it is usually only a rapid method of reaching a wrong conclusion.

As Professor Stengel has said "An occasional apparent hit by this method may do great harm to a group of assistants or a class of students by leading them to believe that the more toilsome method is not necessary. The latter plan is less dramatic but far and away more certain and valuable."

Some intelligent men never become good diagnosticians. The incapacity may be due to deficient training, lack of interest, laziness, the use of poor methods, unwillingness to take pains, dominance of a temperament, the riding of a hobby, chasing the elusive will o' the wisp of imperfect and unsound knowledge.

Men are prone to think they see the things which they expect to see, wish to see or fear to see.

A predominant idea may exclude or blur the optical images which, were they admitted to consciousness, would give rise to ideas which would be registered as memories. Even the things seen may be seen incorrectly or incompletely, and things which are not there may be described. Similarities are recognized more certainly than differences unless the differences are very conspicuous.

Reid in *Principles of Heredity* says "As is well known we are apt to overlook considerable differences especially in unfamiliar forms unless our powers of observation have been trained by experience. Thus we are able to detect most differences between people of our race, but Chinamen are much alike to us. The ordinary man hardly knows one sheep from another—the shepherd knows every member of his flock."

Fashion and custom in surgery may control a diagnostic decision. One is apt to find many instances of a disease which is the fashion. We know how often appendicitis is diagnosed when it does not exist and how commonly nephroptosis is pointed out as a cause of neurasthenia when in reality there is no movability of the kidney beyond normal.

Some who love paradoxes are prone to have contempt for the probable, they always seek for the improbable, the unusual, and the bizarre

A neurotic surgeon is particularly prone to obsessions, and enthusiasm is as dangerous as prejudice. A good portion of skepticism plus reasonable accessibility to new impressions is the proper mental atmosphere which favors clear judgment. Some men labor under morbid doubt. Such a man says, "It may be this or it might be that." He brings little comfort to a family physician and none at all to a patient. A surgeon always strives to form a definite opinion (although to do so may be impossible) and if he forms one he will, of course, always have the moral courage to state it.

A diagnostician may fail because of ignorance, stupidity, inability to concentrate the attention, abject subservience to authority, love of new ways and new things, unreasonable worship of old ways and old things, inability to recognize differences and to reject apparent similarities, mental dishonesty, impairment of sight, smell, hearing, or touch, or the use of improper methods. A man who is usually an excellent observer may at times become a poor one. Such a failure may be due to illness, a sleepless night, tire, worry, carelessness which is a child of overconfidence, preoccupation, dropping into routine (as busy dispensary men sometimes do) or attempting to make a brilliant 'intuitive diagnosis.' Bodily tire and mental fatigue make close attention and observation all but impossible.

Logic is described by Sheil as the science of evidence. In order to reason correctly a logical mind is a necessary instrument. It is necessary for the diagnostician to reason correctly on the information furnished by the history and by the examination. The

surgeon must analyze, measure, compare values, separate the casual from the causal, the transitory from the permanent, that which is guessed from that which is known. He must cast out absolutely what Junius called "false facts." Surgical sea serpents and base scientific coin are to be rejected. In reaching a conclusion the surgeon calls upon the memories of his reading and his personal experience in order to compare them, contrasting them with the case which is being studied. Even a good observer will make great mistakes if he is devoid of the logical faculty. Even the best of logicians will make miserable failures if he doesn't possess or doesn't use the faculty of observation.

James Berry in his admirable *Manual of Surgical Diagnosis* says: "Surgical diagnosis ought not to consist, as some students imagine that it does, in the mere fitting of a name to a diseased condition. It should be much more than this, it should aim in ascertaining as exactly as possible and in what respect and to what extent the patient's condition deviates from that of perfect health. In other words it should comprise not only the nomenclature of the disease but also the degree and extent of that disease."

When one endeavors to practice surgery as advised in this article he assumes a great responsibility, and how great a responsibility it is! Vast is the responsibility borne by a conscientious practitioner of medicine or surgery. A very great writer says: "One can fancy how awful the responsibility must be to a conscientious man how cruel the feeling that he has given the wrong remedy or thought it may have been possible to do better, how harassing the sympathy of the survivors if the case is unfortunate how immense the delight of victory." These solemn words as the reader knows were written by William Makepeace Thackeray.

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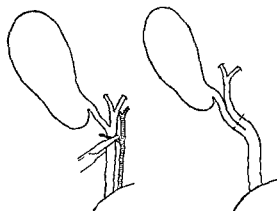


Fig. 1 Injury of common bile duct in clamping abnormal cystic artery

Fig. 2 Division of common bile duct with an adherent cystic duct

difficult or impossible to pass a probe into the duodenum. If the surgeon be satisfied with an incomplete exploration of the duct and proceeds to remove the diseased gall bladder, the obstruction of the head of the pancreas may be sufficient to prevent closure of the stump of the cystic or the opening of the common duct so that a permanent biliary fistula forms and the case then becomes identical with one in which the common duct has been divided.

In the next group, in which there is a complete obstruction the condition is as a rule made evident owing to the fact that there is profound jaundice, a dilated gall bladder containing thick tenacious bile, and a dilated common duct. In some long continued cases, however, the liver completely fails in its function so that both the common bile duct and the gall bladder are filled with an almost colorless bile. The appearance of this material in the gall bladder may suggest that there is cystic duct obstruction, and if the common duct be opened to settle the diagnosis a persistent biliary fistula may form even after the performance of a cholecystenterostomy. In this variety the condition, after a short time will also simulate an accidental division, but the operative procedures will be complicated by the presence of a cholecystenterostomy. In the last group there may be a combination of lesions which will give rise to a considerable amount of difficulty in diagnosis and treatment. For instance carcinoma of the common duct may occasionally be associated with carcinoma of the gall bladder or with calculi in the bladder, or a chronic pancreatitis may be associated with an acute cholecystitis, while yet again a small growth may be found at

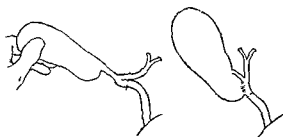


Fig. 3 Tension upon gall bladder causing a loop of the common bile duct which is divided in mistake for the cystic duct

Fig. 4 Common bile duct adherent to Hartmann's pouch and mistaken for cystic duct

the junction of all three ducts. For one or other of these reasons it may be impossible to utilize the gall bladder in the performance of a cholecystenterostomy. If the common duct is much dilated, a lateral cholecystenterostomy by methods of simple suture may be feasible, but if it is only of moderate size such a union may be difficult, and a reconstruction of the lower portion of the duct will probably allow a more satisfactory passage of the bile. A similar technique might be required in the rare condition in which a fibrous stricture has followed cholecystectomy, but in such cases it is probable that the common duct will be sufficiently dilated for the performance of a lateral choledochenterostomy. In all this group, reconstruction will probably be of the lateral type, but since it is generally performed at the time of the first operation it is likely to be associated with fewer difficulties.

#### DANGEROUS COMPLICATIONS

The chief difficulty which will arise in the performance of the terminal reconstruction is that the duct may have been divided very high up. This is especially likely to be the case when the common duct has been accidentally divided in mistake for the cystic duct, for after the first division below the cystic duct the dissection is carried upward and as the gall bladder is removed the common hepatic or the individual hepatic ducts are often divided in the hilum of the liver. In some of my cases so high was the division that it was only after a very prolonged dissection indeed that two small constricted openings were found situated in a mass of scar tissue far up in the hilum. Under such conditions any operation becomes almost impossible, for no portion of normal proximal duct can be obtained with which to make an anastomosis. In any of the secondary operations the dissection will always be prolonged and tedious. There are not only the adhesions arising from the

# CLINICAL SURGERY

## FROM THE SURGICAL CLINIC OF THE LONDON HOSPITAL RECONSTRUCTION OF THE COMMON BILE DUCT

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**R**ECONSTRUCTION of the common bile duct, by which is meant an attempt to fashion an entirely new lower portion of the duct and its opening as distinct from operations of end-to-end suture, may be required after complete division of the duct, either accidentally or by design, or when the duct is still present but shows an irremovable obstruction.

*Accidental division* The operation of cholecystectomy is often fraught with considerable difficulties, and the more frequently it is undertaken the more does the operator realize how easy it is to mistake a portion of the common duct for the cystic duct and to divide it. Anatomical and pathological abnormalities greatly enhance this danger, as shown in Figures 1 to 4, and there is no doubt that accidents of this sort are much more frequent than is generally believed. Of my own series of 24 reconstructions 8 were due to the fact that the common duct had been accidentally divided at a previous operation and often by surgeons who were well skilled in operative technique. These and other reported cases give, however, no true indication of the frequency of the lesion, for many do not survive the accident, while others in whom the accident had been recognized at once have recovered after an immediate end-to-end suture which has correctly been chosen because success is more likely to follow the suture of normal tissues than the plastic procedure undertaken on inflamed and scarred material.

Should the injury be overlooked or the primary suture fail, the duct may become obstructed at the site, in which case the portion above will become much dilated, a change which will make the technical steps of the reconstruction operation much easier, but at the same time the patient will become deeply jaundiced, and if left for any length of time will suffer from hepatic insufficiency so that the operative risks will be greatly increased. More commonly, however, bile is dis-

charged from the wound and after a short time a well defined sinus is left from which all the bile escapes. The upper part of the duct will then be collapsed, and in long standing cases may be extremely difficult to find. The patient, however, will not be suffering from jaundice and will be in a much better general condition and thus better able to withstand the stress of a prolonged operation. In either case the portion of the duct below the injury will after a few weeks become so collapsed and involved in scar that it is very rarely recognized.

*Operative resection of a portion of the duct* A gap may be designedly made in the course of the duct, either because there is a congenital absence of the cystic duct, in which case the hepatic and common ducts open separately into the gall bladder and thus are not in continuity after a cholecystectomy or because in a relatively few suitable cases a benign or carcinomatous stricture is present and an attempt can be made to remove it. As a rule but few of these cases require an operation by the reconstructive method, for generally the primary procedure is so designed that an immediate end-to-end suture is possible. Occasionally so large a portion of the duct has to be removed that an approximation is impossible even after free mobilization of the duodenum. In such cases a reconstruction may be essential.

In these two groups, which include the greater number and the more important cases, the reconstruction operation is undertaken by the terminal method.

*Irremovable obstruction in continuity* From the point of view of surgical technique, these cases may be considered in three groups. In the first variety there is disease of the gall bladder, such as cholecystitis and gall stones which is associated with a mild degree of obstruction of the common duct from an associated chronic pancreatitis. This obstruction is insufficient to have led to a dilatation of the common duct, although it may be



Fig 5 Flap has been cut on the anterior surface of the duodenum.

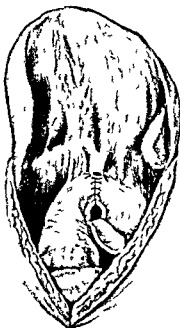


Fig 6 Upper portion of opening in duodenum is sutured to leave opening of same caliber as divided duct

increased by the fact that under the anæsthetic the secretion of bile often appears to be in abeyance so that none escapes from the opening. The dissection must, however, be most carefully continued until the surgeon is confident either that he has found the opening above into the divided duct or that he can recognize the dilated duct. The portal vein may sometimes in this difficult resection resemble a dilated duct and if the surgeon is at all uncertain he may insert a small hypodermic needle mounted on a syringe, and the withdrawal of either blood or bile will at once make clear to him whether he is dealing with the duct or the vein. With an irremovable obstruction, the dilated duct should be freed as low as possible so that the anastomosis can be performed close to the duodenum. If there is a benign or carcinomatous stricture which has to be removed, this must be carefully freed so that it can be recognized in its full extent. These preliminary steps in the recognition of the nature or site of the lesion having been performed, the surgeon will proceed to carry out the reconstruction. If the obstruction is irremovable and a cholecystenterostomy is not possible, this will be of the lateral type, whereas if the duct has been divided it will be terminal.

**Terminal reconstruction** If in the dissection the duodenum has not been freely mobilized, the

lateral peritoneal folds should be divided and the duodenum mobilized until it can be drawn up without tension to the hilum of the liver. In some cases in which the remaining portion of the common bile duct is sufficiently long, this mobilization may permit of direct implantation of the duct into the duodenum, a method which should be carried out wherever possible but in the majority the remaining portion of the duct is of insufficient length to permit this, and a true reconstruction will have to be performed. A catgut suture is passed through the upper border of the duodenum and through the posterior wall of the divided duct and tied, the two structures being thereby drawn as nearly into apposition as possible. The union between the divided duct and the upper border of the duodenum is completed either with a continuous or with a few interrupted sutures. A flap is now cut on the anterior surface of the duodenum in such a way that the resulting opening in the duodenum is immediately opposite the cut end of the duct and the flap is turned downward (Fig 5). The upper portion of the opening of the duodenum is sutured with chromic gut until the opening that is left below is of the same caliber as the divided duct (Fig 6). A piece of tube about  $1\frac{1}{2}$  inches in length and of the largest possible diameter is inserted into the divided duct and sutured in place with one stitch of plain catgut. Its lower end is

first operation but there has usually been a considerable amount of inflammatory change owing to the passage of bile. The duodenum may be firmly adherent to the under surface of the liver, and the gall bladder has usually been removed so that there are few if any anatomical landmarks which will help the surgeon to determine the level of the individual structures. The remaining difficulty lies in the fact that these patients are as a rule very poor operative risks. In some cases there has been not only a preliminary operation but several attempts to reconstruct the duct. In addition there has been either the wearying effect of a long continued biliary discharge or a profound jaundice with a varying degree of hepatic insufficiency.

#### PREPARATION FOR OPERATION

All these enfeebled patients should have a period of complete rest in bed and careful preparation. If there has been marked jaundice a course of calcium medication may be necessary to lessen the danger of hæmorrhage. In other cases the patient should be admitted to the hospital at least 48 hours before the operation is undertaken. If there is a biliary fistula this should be carefully cleaned, the patient be placed on a light diet, and the bowels freely opened but not unduly purged. No solid food is given in the last 18 hours before the operation but 3 or 4 hours before a few ounces of meat broth are administered and a hypodermic injection of  $\frac{1}{100}$  grain atropine is given  $\frac{3}{4}$  hour before the operation is due.

#### TECHNICAL STEPS OF THE OPERATION

Anæsthesia may be induced either with ether or with local infiltration methods. Chloroform should be avoided, for so often the liver is functioning poorly. My own preference is for open ether or warm ether vapor. With a skilled anæsthetist, this method will give a most satisfactory anæsthesia producing no ill after effects, and not only does its induction occupy a shorter period than the local anæsthetic, but it has the benefit of producing unconsciousness in the patient. Access is best obtained by a long right pararectal incision. Frequently this is carried out in the form of an ellipse so as to excise the old scar and to encircle any biliary sinus. It should be carried well up the angle between the xiphisternum and costal margin, but very rarely indeed have I found it necessary to combine it with an oblique incision of the upper end. If the patient has the upper abdomen thrown forward by a sandbag or the raised cross bar of the operating table a long pararectal incision will give the most ideal access, and

it is my incision of choice for all operations upon the stomach, duodenum, gall bladder, and pancreas.

The anterior sheath having been divided in the whole length of the incision the right rectus is displaced outward. On account of the previous operation this may take a little time, as the muscle is now adherent and does not strip readily from its sheath. The posterior sheath and peritoneum should be divided in the upper part of the incision, for not infrequently the omentum, colon or stomach may be adherent to the anterior wall. Such adhesions are less frequently found over the surface of the liver, but if present and the incision be accidentally made too deep little or no harm will result in making a small nick into the liver, whereas an incision into one of the hollow viscera may occupy considerable time in its repair. When an opening has been made in the upper part of the peritoneal cavity, a finger is inserted and the extent of the adhesions determined. The peritoneum can then be opened to the lowest point of the incision as the adhesions are gradually freed. It is essential before any attempt be made to locate the common bile duct, that the anterior layer of peritoneum be freed from adhesions and that the liver, colon, stomach, and duodenum be isolated and identified. In the cases of irremovable obstruction no difficulty will be found in recognizing the dilated gall bladder and the common bile duct, but in the difficult cases where the gall bladder has been removed the duodenum will generally be found adherent to the under surface of the liver. An automatic retractor should be inserted so as to separate the two sides of the incision widely, and the stomach and colon should be carefully held aside with gauze packs. The duodenum is now most carefully and gently dissected from the under surface of the liver for it is the upper border of the first part of the duodenum which will be the only safe landmark to the surgeon. As soon as possible a finger should be inserted into the foramen of Winslow and by the lifting forward of the anterior border of the gastrophrenic omentum the portal vein and hepatic artery will be elevated. If there is a biliary sinus, a probe may sometimes be passed up it into the common bile duct and if there is complete obstruction, the dilated upper end of the common duct may become visible after a little dissection. It is however, in the recognition and isolation of the structures in the gastrophrenic omentum that so much time may be occupied. The fibrous tissue is often dense and adherent, and the opening of the sinus may be so small that it is recognized with great difficulty—a difficulty which may be

continued biliary fistula, or is suffering from back pressure with hepatic insufficiency, or if performed as a primary operation after resection of a portion of the duct the operation itself is generally a tedious procedure in a patient who is often enfeebled. The lateral reconstructions are also performed on feeble and exhausted patients who are suffering not only from carcinoma or chronic pancreatitis but who have been for long subjected to biliary back pressure. Immediate operative shock will therefore give a high mortality, but if this be overcome, the only special risk is that of leakage from the anastomosis. With careful suturing this should be reduced to a minimum and be but little greater than after a partial gastrectomy. Early leakage will cause a duodenal fistula which if small will close naturally in a few days, but if large, will be a progressive and dangerous complication. If occurring later it may give rise to a local abscess instead of a fistula.

My own series of 24 cases included 9 of terminal reconstruction, 12 of lateral reconstruction, 2 of immediate end to-end suture, and 1 of overlooked division.

**Terminal reconstruction.** Of the 9 cases in this series 2 died as the result of operation, one being performed after the resection of a carcinoma of the duct, and the second after an operative injury of 5 months standing. Of the remaining 7, 3 have remained well and free from all symptoms for periods of 10  $\frac{1}{2}$  and 3 years respectively; one has had slight occasional attacks of jaundice; 2—both of whom had had several previous attempts at reconstruction and showed very narrow ducts far up in the hilum of the liver—have been failures with a return of obstructive jaundice and 1 died 3 years after operation with jaundice and pyrexia.

**Lateral reconstruction.** Of the 12 cases in this group 6 died as a result of the operation, a very high immediate mortality but 3 had far advanced carcinoma of the lower duct and 3 showed the ducts full of a clear mucoid fluid, the



Fig. 8 The lower end of the tube is inserted into opening in duodenum and the flap turned upward over tube. The flap is sutured above to the duct and at sides to anterior wall of the duodenum.

so called 'white bile,' the presence of which is an indication of severe hepatic insufficiency. Of the 6 who recovered from the operation, 3 had carcinoma of the ducts from which they died at a later period. Two of them showed the presence of white bile at the operation but nevertheless recovered from the operation and lived 4 and 15 months respectively before dying with secondary growths. In 3 cases the operation was performed for obstruction due to chronic pancreatitis and the presence of some condition which prevented the performance of cholecystoduodenostomy or gastrostomy. These patients are alive and free from all symptoms for 3, 6, and 6 years respectively after operation.





Fig. 7. A tube  $1\frac{1}{2}$  inches long and of largest possible diameter is inserted into divided duct and sutured into place with one stitch.

now inserted into the opening in the duodenum and the flap turned upward over it. In the upper portion the flap is sutured carefully to the duct and laterally to the anterior wall of the duodenum which lies behind the tube (Fig. 8). By this means a free but valvular opening is made and the new portion of the duct is formed by the flap of the duodenum, which is lined with mucosa accustomed to the passage of bile. A tube is inserted down to the junction in case there should be any leakage and the wound is then closed. It is this type of operation which is most frequently required. It will be found in practice that once the proximal end of the duct has been recognized and isolated, the operation is simple to perform and a new duct of practically any length can be fashioned from the duodenal wall.

**Lateral reconstruction.** The steps of this operation are very similar. A lateral opening is made into the dilated duct as close to the duodenum as possible. If there is any gap between the opening and the duodenum, the wall of this latter structure is drawn upward and sutured to the duct immediately below the opening. A tube is inserted into the duct and sutured in position with plain catgut. A flap is then made in the duodenum in the usual way and sutured round the tube again, thus giving a valvular opening lined with duodenal mucosa. In either case a tube is inserted down to

the junction for a few days in case there should be any leakage of bile but in satisfactory cases this should not take place. The bile should immediately pass along the tube into the duodenum.

#### POSTOPERATIVE CARE

The patient is returned to bed and as soon as he begins to recover from the effects of the anæsthetic,  $\frac{1}{4}$  grain of morphia and  $\frac{1}{100}$  grain atropine are administered. His head is gradually raised and when he is well round he is propped up until he is in a sitting posture. For the first 24 hours small sips of water just sufficient to moisten the mouth are given, and morphia should be administered as often as necessary. The room is kept warm with the window closed, for with so prolonged an operation there is always the danger of postoperative lung complications. After 24 hours the amount of fluid given by the mouth is increased to 2 drams, and may consist either of water, diluted tea, or lemonade. The amounts of fluid are gradually increased until on the third day he is having 1 ounce drinks hourly. On the fourth or fifth day the amount is increased to 2 ounces, and a little jelly, junket, or custard is added. The quantities of fluid and food are steadily increased after this until the tenth day his diet includes fish, eggs, and a little chicken. The wound should be dressed on the second day and if there is no leakage of bile the tube may be withdrawn for 2 to 3 inches and the excess cut off. On the fourth day it should be dressed again and if there is still no leakage the tube may be completely removed. Very often evidence of the satisfactory progress of the operation may be obtained in the first 24 hours for if there be postanæsthetic vomiting the vomitus may contain bile indicating that it is freely passing into the duodenum. On the third day an enema should be given, and thereafter a careful watch must be kept on the stools to determine whether the bile is passing freely into the intestines. A watch must also be kept for the passage of the tube. Having been sutured in place with one suture of catgut, it will usually pass into the intestine on about the eighth or tenth day but in some cases it is retained for a considerably longer period and the stools should be carefully watched until it is found so that it may be determined with certainty that it has been passed.

#### RESULTS OF OPERATION

Either variety of operation is of necessity associated with a high mortality. With a terminal reconstruction the patient has either been exhausted by previous operations and a long

colic anastomosis. The proximal jejunal loop is made as short as is consistent with the extent of the resection. Two small crushing clamps are applied to the jejunum at the site selected for the anastomosis (Fig 2). These clamps are placed side by side, extending transversely across three-fourths of the diameter of the intestine (about  $\frac{1}{4}$  inch of jejunum is left at the mesenteric border). An incision is made between these clamps and their handles are separated. The length of the jejunal incision, after separation of the clamps is usually from 2 to 2 $\frac{1}{2}$  inches. In those instances in which the proximal jejunum is smaller than the average, a larger stoma may be obtained by the application of the clamps as in Figure 4 and the excision of a wedge of jejunum. By this device the length of the opening is increased by approximately one third.

This portion of the jejunum is then united to the cut end of the stomach by a row of interrupted silk sutures forming the posterior suture line (Fig 2). The crushing clamps are removed. The open ends of the stomach and jejunum are then united in the following manner. A continuous through and through catgut suture is inserted beginning in the middle of the anastomosis posteriorly and is continued in both directions. This suture is carried around either angle as a continuous inverting mattress stitch (Connell's suture). The stomach is not puckered but the excess is closed in the usual manner. The anterior portion of the suture line is reinforced with a row of interrupted sutures of fine silk.

The jejunum and the stomach are then drawn through the opening in the transverse mesocolon. The cut edges of the mesocolon are sutured to the stomach with interrupted sutures of silk. The anastomosis is complete. The transverse jejunal incision may be utilized with antecolic or retrocolic anastomoses.

In the antecolic operation it is advisable to make an entero enterostomy between the proximal and distal jejunal loops. In operations of the Billroth II type the cut end of the stomach is closed and a posterior side to side gastrojejunostomy is made with a transverse jejunal incision (Fig 3).

This procedure has been utilized in four instances including Billroth II retrocolic Polya and antecolic Balfour Polya types of procedures.

#### CASE REPORTS

**CASE 1.** The patient J. L. a white male 67 years of age was admitted to the New Haven Hospital on April 7, 1923, complaining of indigestion. About 18 months before admission the patient commenced to suffer from

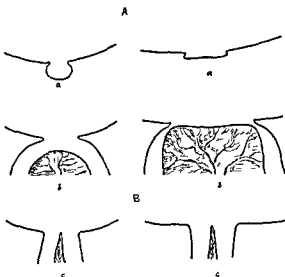


Fig 1. A diagram showing the effect of extreme gastric dilatation on the stoma. A in the usual side to side gastroenterostomy (longitudinal jejunal incision). B in the new type of procedure (transverse jejunal incision). The normal stoma is represented in the usual procedure in a and b in cross section and longitudinal section respectively and c represents a longitudinal section through the stoma after a gastro enterostomy with a transverse jejunal incision. The dilated stomach is represented in a, b and c. The mechanism of valve formation is illustrated in a and b while in c' the dilatation produces an enlargement of the stoma.

dull epigastric pains. At the same time he began to lose weight and strength. The family history and personal history were irrelevant. On admission to the hospital the patient was poorly nourished and showed evidence of loss of weight. There was an indefinite mass in the right upper quadrant of the abdomen. A rectal examination was negative. An X ray examination showed a filling defect at the pylorus with partial obstruction.

**Clinical diagnosis.** Carcinoma of the stomach. April 13, 1923 a laparotomy was performed. A freely movable carcinoma of the stomach was found with partial pyloric occlusion and metastases to the regional pyloric lymph nodes. The following procedure was then done: partial gastrectomy—end to end gastro enterostomy with a transverse jejunal incision (antecolic Balfour Polya type) lateral anastomosis between proximal and distal jejunal loops. The immediate convalescence was entirely uneventful. There was no nausea or vomiting. The wound healed *per primam*.

May 7, 1923. An X ray examination showed that the stomach was emptying satisfactorily. There was no retention of barium after 6 hours. The patient was discharged 24 days after operation.

**Subsequent course.** The patient remained in fair condition for about 9 months. There was slight abdominal pain but no nausea or vomiting. In January 1924 he commenced to lose weight and suffered from more pain. There were no symptoms suggesting obstruction at the anastomosis. The patient died on February 14, 1926.

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## GASTROJEJUNOSTOMY WITH A TRANSVERSE JEJUNAL INCISION FOLLOWING A PARTIAL GASTRIC RESECTION

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THE longitudinal jejunal incision impairs the efficiency of the resulting anastomosis in the usual methods for making a gastrojejunostomy. The orthodox jejunal incision (longitudinal) necessarily severs the circular muscle fibers throughout the length of the stoma. The contraction of the severed circular muscle fibers can have no effect on the propulsion of food along the intestinal canal but merely shortens the distance between the edges of the anastomotic opening. Consequently there is a tendency to the formation of an atonic dilated pouch in the jejunum immediately opposite the stoma, in many instances after the Pólya type of procedure. The proximal and distal jejunal loops naturally gravitate downward at either end of the stoma with the production of an acute angulation that may result in a partial obstruction. These shortcomings can be obviated by the utilization of a transverse jejunal incision.

Although the inherent mechanical deficiencies of the orthodox side to side gastrojejunostomy were clearly demonstrated by Cannon and Blake (1) about 20 years ago, surgeons have failed to make a clinical application of their observations. These investigators repeatedly observed the passage of food through the patent pylorus into the duodenum and back to the stomach via the gastroenterostomy opening. This circulation of food usually occurred when the stomach was dilated by large amounts of food and water. The phenomenon is the result of valve formation at the anastomosis. When the wall of the stomach is stretched so that the edges of the opening into the jejunum are separated, the intestinal wall becomes flattened over the stoma and the openings into the stomach are converted into narrow slits. The opening on the proximal side of the stoma is patent for food which circulates via the pylorus and duodenum into the stomach but both slits act as valves preventing the egress of food from the stomach (Fig. 1). The valves become more effective with greater gastric dilatation. Cannon and Blake also demonstrated this phenomenon by distending the excised stomach with water.

In previous communications (2 and 3) experiments were reported in which a comparison was

made between gastroenterostomies (in dogs) performed according to the orthodox technique with those in which a transverse jejunal incision was utilized. In the latter group there was no tendency to the formation of a valve. In fact dilatation of the stomach had the opposite effect of enlarging the stoma and maintaining its patency (Fig. 1). In contrast there were three poor results in ten anastomoses made with the usual longitudinal jejunal incision. In these animals the stoma was much enlarged and a definite valvular obstruction was evident. There were no adhesions or permanent kinks and the obstruction could be attributed to the valve formation only.

In further studies (4) a transverse jejunal incision was utilized in an end to end gastrojejunostomy after a partial gastrectomy. This method has the following advantages. The procedure is an end to end anastomosis and has the mechanical and physiological advantages that are generally conceded to this type of operation. In addition the interference with peristalsis that follows a division of the circular muscle fibers is avoided and conditions favorable to the formation of an atonic pouch are not produced. After this end to end gastrojejunostomy the jejunal loops naturally gravitate downward which is the optimum position for the maintenance of a patent stoma, while this same tendency after anastomoses of the Pólya type may tend to kink and partly occlude the lumen.

The purpose of the present communication is to present the clinical application of the transverse jejunal incision in restoring the gastrointestinal continuity following a partial gastrectomy. This incision has been used in operations of Billroth II and Pólya types.<sup>1</sup>

## OPERATIVE TECHNIQUE

The operation (Pólya type) is performed in the following manner. After a partial gastric resection has been completed the jejunum is brought through an opening in the transverse mesocolon and approximated to the stomach for a retro-

<sup>1</sup>The terms Billroth II type and Pólya type are used to designate anastomoses made between the jejunum and the post-canal wall of the stomach at the transected end of the stomach respectively after a partial gastric resection.

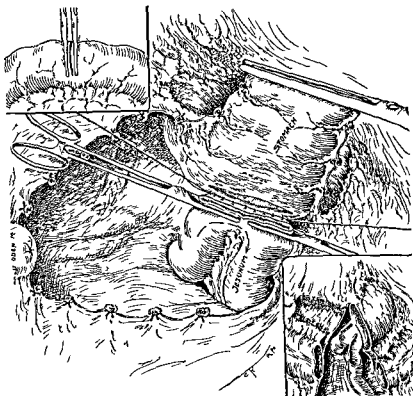


Fig. 3 The drawing illustrates the method of performing a retrocolic anastomosis (Billroth II type) with a transverse jejunal incision. The stomach has been lifted toward the left. The clamps have been separated and the jejunum has been approximated to the posterior wall of the stomach along the line of the proposed gastroenterostomy stoma. The posterior row of interrupted sutures has been completed. The anastomosis is completed according to the usual methods. The end of the stomach is closed after a transection along the dotted line. The upper insert shows the method of applying the clamps and making the transverse jejunal incision. In the lower insert a portion of the transverse colon is omitted and the anterior portion of the stomach and jejunum at the anastomosis have been excised in order to show the appearance of the completed anastomosis from within.

The transverse jejunal incision was utilized in making a posterior gastroenterostomy (Billroth II type) following a partial gastric resection for a coexistent gastric and duodenal ulcer. The anastomosis has functioned satisfactorily for about 3 years. The patient has had a complete symptomatic relief.

**CASE 3.** The patient A. R., a white woman 67 years of age, was admitted to the New Haven Hospital October 15, 1926, complaining of stomach trouble. The patient states that she has suffered from abdominal discomfort for about 6 years. At first there was a localized dull pain coming on 15 to 20 minutes after eating. This was associated with gaseous eructations and occasional vomiting. During the last year the pain has become more severe and the vomiting more frequent. She has lost about 25 pounds during the last 3 weeks. At the time of admission the pain was continuous.

The family and personal histories were irrelevant.

On admission to the hospital the patient was found to be poorly nourished and suffering from abdominal pain. There was a freely movable mass just to the right of the umbilicus. Rectal examination was negative. An X-ray examination showed a very narrow streak of barium passing through the pylorus. There was no 6 hour residue.

**Clinical diagnosis.** Carcinoma of the stomach.

October 27, 1926. Laparotomy was performed. The findings were an annular carcinoma of the pyloric portion of the stomach with a partial pyloric stenosis and metastases to the regional pyloric lymph nodes. A partial gastrectomy was done, end to end gastroenterostomy with a transverse jejunal incision (retrocolic Pólya type). The immediate convalescence was entirely uneventful. There was no nausea or vomiting.

November 10, 1926. An X-ray examination showed the stomach emptying satisfactorily. There was no gastric residue after 6 hours. The patient was discharged twenty days after operation.

May 3, 1927. General condition was good (7 months after operation). There was no evidence of a recurrence.

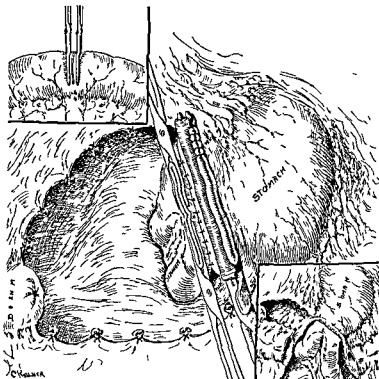


Fig. 2 The drawing illustrates the method of performing a retrocolic anastomosis (Pólya type) with a transverse jejunal incision. The resection is complete. The clamps have been separated. The jejunum has been approximated to the transected end of the stomach and the posterior row of interrupted sutures has been completed. The clamps are now removed and the anastomosis is completed in accordance with the usual methods. The upper insert shows the method of applying the clamps and making the transverse jejunal incision. The insert is partly diagrammatic as in practice the clamps are placed as close together as possible. In the lower insert a portion of the transverse colon is omitted to show the completed anastomosis as it appears *in situ*.

The transverse jejunal incision was utilized in making an end to end gastro enterostomy following a partial gastrectomy for carcinoma of the stomach. The stoma functioned satisfactorily for 10 months. The patient died of a recurrence of the neoplasm without evidence of encroachment on the lumen of the anastomosis. The freedom of the patient from any symptoms of obstruction is indicative of the mechanical efficiency of the anastomosis.

**CASE 2** The patient C. A. a white male 52 years of age was admitted to the New Haven Hospital on March 22, 1926 complaining of epigastric pain. The patient had an attack of dull epigastric pain in 1915. Two years later he had a second attack and since that time they have gradually increased in frequency. The duration of the pain varied from 12 to 48 hours. A sore spot persisted in the upper abdomen between attacks. The family history and personal history were irrelevant. On admission the

patient's general condition was good. There was a tender spot just to the right of the umbilicus. The examination was otherwise negative. An X-ray examination showed a filling defect in the pyloric antrum. The stomach emptied slowly and there was a considerable retention of the barium after six hours.

**Clinal diagnosis** Carcinoma or ulcer of the stomach. March 24, 1926. Laparotomy was performed. The findings were a duodenal ulcer with partial pyloric occlusion and an ulcer on the posterior wall of the stomach near the lesser curvature in the pyloric region. Partial gastrectomy was done, a posterior gastro enterostomy with transverse jejunal incision (Billroth II type). There was no nausea or vomiting. The wound healed *per primam*. An X-ray examination (April 8, 1926) showed a normally functioning stoma. There was no gastric residue after 6 hours. The patient was discharged 16 days after operation.

December 4, 1926. The patient has been relieved of his symptoms. An X-ray examination showed a normally functioning stoma. There was no gastric residue after 6 hours.

November 19, 1928. The patient is in excellent general condition and has no gastric symptoms.

the length of the incision is approximately equal to twice the diameter of the intestine. It should be emphasized that the greater possible length of the longitudinal jejunal incision does not increase the efficiency of the anastomosis as the maximum possible size of the *effective lumen* in any type of anastomosis can be no larger than a cross section of the intestine at the level of the anastomosis.

The advantages of the transverse jejunal incision according to the new method are several. The circular muscle fibers are not severed and accordingly there is a minimal interference with peristalsis, the afferent and efferent intestinal loops gravitate downward without linking into the optimum mechanical position, there is no tendency for distention of the stomach to produce a valvular obstruction but on the contrary it maintains the patency of the lumen.

The utilization of the transverse jejunal incision in a simple posterior gastro enterostomy has been previously reported. In the present communication a report is made of the application of this procedure in anastomoses of the Billroth II and Polya types.

The results of the clinical application of the transverse jejunal incision in anastomoses following a partial gastrectomy are presented. The method has been utilized successfully in many experimental animals and in four patients following partial resection of the stomach. Two of the four patients died of recurrence of the gastric cancer 10 and 28 months after operation respectively. They benefited for periods of 9 and 24 months of relief from obstructive symptoms. The two other patients are alive and well at the present time, the one with a gastric ulcer about 3 years after operation and the other for 9 months after resection of a gastric cancer. The latter patient shows no evidence of a recurrence. The former has been completely relieved of all gastric symptoms.

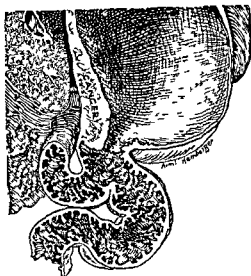


Fig 5 The drawing shows the anastomosis as it appeared in the fixed specimen removed at autopsy in Case 3. The recurrence of the neoplasm along the lesser curvature partly occluded the stoma. The healing at the anastomosis was perfect.

Although the results are not brilliant in regard to the cure of gastric cancers, they are illustrative of the excellent mechanics of gastro intestinal anastomoses in which the transverse jejunal incision is used.

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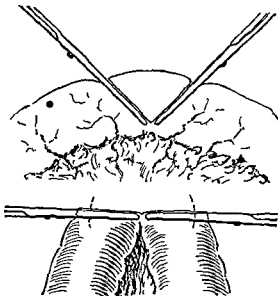


Fig 4 The diagram (upper figure) shows how the clamps may be placed in instances in which the proximal jejunum is unusually small. In the lower figure the wedge of jejunum has been excised and the clamps separated. This device increases the length of the stoma by approximately one third. The broken lines mark the length of the opening obtained when the clamps are placed as in Figures 2 and 3.

September 17 1928 General condition unchanged except that the patient felt weak. No definite evidence of a recurrence was found. An X ray examination showed that the stoma was emptying satisfactorily. There was no residue after 6 hours.

December 8 1928 For about 6 weeks the patient has complained of weakness loss of appetite and epigastric pain. There was no nausea or vomiting. She had lost about 10 pounds in weight. Examination showed definite jaundice. There was a large palpable mass in the right upper quadrant of the abdomen.

Final note The patient steadily declined and died on February 13 1929. During the last 6 weeks the pain became more severe and morphia was required for relief. During the 2 weeks before death there was some nausea and vomiting.

The autopsy findings were a recurrence of the carcinoma with complete occlusion of the common bile and pancreatic ducts. The greater part of the recurrent neoplasm was extra gastric although there was extension of the growth into the stomach along the lesser curvature (Fig 4) with partial occlusion of the anastomosis. This probably accounted for the terminal vomiting.

An end to end gastro-enterostomy with a transverse jejunal incision was performed following a partial gastric resection for carcinoma (retrocolic Polya type). The anastomosis functioned satisfactorily. The patient remained in good health for about 2 years when evidences of a recurrence of the neoplasm were observed. The

patient became jaundiced and died on February 13, 1929. The anastomosis functioned adequately, as is evidenced by the absence of nausea and vomiting until the terminal stages of the disease. At autopsy the neoplasm had encroached on and partially occluded the stoma.

CASE 4 The patient L. S. a white woman 67 years of age was admitted to the New Haven Hospital on June 14, 1928, complaining of stomach trouble. About 6 years before admission the patient commenced to have mild distress in the epigastrium associated with flatulence and belching. Three months before admission she passed several loose black tarry stools. She lost about 15 pounds in weight during the last few months before admission to the hospital. She had not had any nausea or vomiting. The general physical examination was essentially negative. The dilated stomach was visible and palpable. A mass was felt extending transversely across the epigastrium toward the right side. An X ray examination showed a filling defect completely obliterating the pyloric portion of the stomach. There was a marked 6 hour residue.

Clinical diagnosis Carcinoma of the stomach. Laparotomy was done June 19 1928. The findings were a carcinoma of the lesser curvature and metastases to the regional lymph nodes. Partial gastrectomy and end to end gastro-enterostomy with a transverse jejunal incision (retrocolic Polya type) were performed. The patient vomited a few times immediately after operation. Convalescence was otherwise uneventful. An X ray examination before discharge showed that the anastomosis was functioning satisfactorily. There was no residue after 6 hours. The patient was discharged 20 days after operation. November 12 1928 The patient has been completely relieved of her symptoms. There has been no nausea or vomiting. An X ray examination showed that the anastomosis was functioning perfectly. There was no residue after 6 hours.

The transverse jejunal incision was utilized in making a retrocolic end to end gastro-enterostomy following a resection of a carcinoma of the stomach. The patient was in good condition about 9 months after operation. There was no evidence of recurrence. The anastomosis is functioning satisfactorily.

#### DISCUSSION

The prerequisite of a successful gastro-intestinal anastomosis is a high degree of mechanical efficiency of the end result. The deficiencies of the longitudinal incision and the efficiency of the transverse jejunal incision have been demonstrated by previous clinical and experimental studies.

Although the utilization of the transverse jejunal incision in performing a gastro-enterostomy is not entirely new, the older methods fall short of completely developing the possibilities of the transverse incision. According to the older methods (Kocher, Mikulicz) the maximal size of the opening is equal to the diameter of the intestine but in the operation described in this paper

the length of the incision is approximately equal to twice the diameter of the intestine. It should be emphasized that the greater possible length of the longitudinal jejunal incision does not increase the efficiency of the anastomosis as the maximum possible size of the *effective lumen* in any type of anastomosis can be no larger than a cross section of the intestine at the level of the anastomosis.

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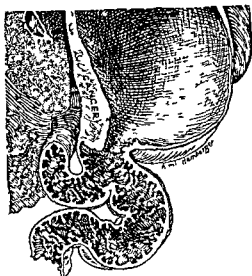


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## THE PREVENTION OF ABDUCTOR PARALYSIS IN THYROIDECTOMY

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UNILATERAL abductor paralysis is unfortunate, bilateral abductor paralysis is a tragedy. It is scant comfort to the surgeon—and certainly no comfort to the patient—to have the paralysis appear several days after the operation or after the patient leaves the hospital. Frazier, Sir Charles Ballance, and others have made contributions to the subject of nerve anastomosis, but there is still much to be done in this field. Massage, electrical treatments, local applications, yield meager net results. Prevention is the ideal treatment.

The prevention of abductor paralysis has little to do with a knowledge of anatomical landmarks—every student of surgery knows where those nerves are! The surgeon experienced in thyroidectomy reviews the position of the recurrent nerve as an evil memory. It is not its anatomical location, however, but rather the vulnerability of its structure, the neighborhood changes of fixation and adhesions, and certain characteristics of the nerve conduction, which form the hazards.

*Vulnerable structure of the recurrent nerve.* The slightest direct or even indirect, pressure on the recurrent nerve interferes with nerve conduction and immediately changes the voice. By contrast, the peripheral nerve fibers can undergo much trauma without resultant motor or sensory disturbance, but the naked recurrent nerve is almost as sensitive as is the naked brain or the spinal cord. Struggle and survival probably have not influenced such vital organs as the larynx and trachea which have always demanded complete protection, the alternative being death. Whatever the cause, these nerves are exceedingly sensitive, exceedingly delicate, and the action current through them is easily blocked. In their vulnerability the recurrent nerves must be classed with the brain, the spinal cord, the optic, the auditory, and the splanchnic nerves. The exceeding vulnerability of the recurrent nerve is, therefore, the first and most important factor in the production of abductor paralysis.

*Neighborhood changes.* A most important neighborhood change is the formation of adhesions between the capsule of the thyroid and neighboring structures including the recurrent nerves. Such adhesions are frequently seen in cases of hyperthyroidism, of thyroiditis, of malignant growth and following excessive radiation. The

role which adhesions play in the production of abductor paralysis will be referred to later.

*The fixed point of the nerve.* The recurrent nerve enters the box of the larynx and is attached to the abductor muscles (Fig. 1), and for this reason it has something of the vulnerability of the nerve root of the spinal nerves. The exquisite sensibility of the laryngeal mucosa is of the order of the sensibility of the cornea, the sensibility of the laryngeal nerve is comparable to that of the optic nerve. Here we have an ideal setting for trouble—a slender, highly vulnerable nerve, its normal attachment rather indifferently secured by the ramifications of cervical fascia, and when a goiter is present, by adhesions—a loose-lying vulnerable nerve, one part attached to a goiter which is movable and the end fixed to the larynx.

The most common direct cause of abductor paralysis is the pull on the nerve which may occur when the goiter is rolled out. The most disastrous effect is produced when the nerve is disturbed by the dislodgement by the finger of an upper lobe which has thrust itself behind the larynx. Such a direct pressure and pull on the laryngeal nerve have probably caused more paralyses than either forceps or knife. Any pull on the nerve may cause partial and temporary, or complete and permanent paralysis. By this I do not mean to imply that the recurrent nerve is never injured directly by forceps or knife by rough sponging, or by packing to control bleeding, however, abductor paralysis is probably most frequently caused by traction.

*Late paralysis due to scar formation.* It is certain that if the nerve trunk is directly exposed in the course of the operation the exposed nerve will be covered by scar tissue. Scar tissue is capable of producing a block of the action current, hence of causing a physiologic severance of the nerve, and this is as great a tragedy as direct division of the nerve for no plastic operation can be done and usually conduction is not re-established.

*Prevention.* In order to protect the recurrent nerve, therefore, resection must be made without the use of force in rolling out or in elevating the goiter. The following technique has given us excellent results.

- a. The usual skin incision.
- b. A V shaped cut upward and downward between the platysma and the skin sufficient to



## RUPTURE OF THE BLADDER

A CLINICAL STUDY OF FIFTY FIVE CASES<sup>1</sup>

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OF major injuries to the urinary bladder rupture is the most frequently observed and is of the gravest concern. Bladder wounds, whether caused by penetration from without (gunshot, sharp pointed instruments, etc.) or by perforation from within by cystoscope or lithotrite, present fewer diagnostic difficulties and the ultimate mortality is lower even though the same surgical procedures must be employed as when one treats bladder ruptures. The great difficulty encountered in correctly diagnosing vesical rupture and the high mortality resulting from the lesion, renders this comparatively rare condition of great clinical interest. In many instances the diagnosis is made only at operation or autopsy. Treatment demands early and rapid operation with the institution of ample bladder drainage. Of the 55 cases here reported from Bellevue Hospital, 35 died—a total mortality rate of 63.6 per cent, which though high, is quite in harmony with the observations of others who have studied this subject.

Over 90 per cent of vesical ruptures occur in males. Explanation of this incidence is found in the more violent nature of male activities and work, the lower position of the female bladder within the more ample female pelvis, and the interposition of the uterus between the bladder and the vertebral column. In this series, but three cases of vesical rupture in females were observed. The first, an actress aged 22 years died of vesical rupture and peritonitis induced by suicidal alcoholism. In the second case, a girl of three ruptured during a severe beating, and the third female aged 41, was crushed between two motor cars.

The incidence of ruptured bladder varies from 1 in 5,000 to 1 in 7,500 surgical cases. During the period of this study (January 1, 1914, to July 1, 1928) slightly over 300,000 surgical cases were admitted to Bellevue Hospital with a vesical rupture incidence of 1 in approximately 5,500 cases. The majority of these patients were adult males although the youngest was a girl of three. The ages of these patients is indicated in Table I. It is noteworthy that bladder rupture in the fetus has been observed.

Vesical distention and pelvic anatomy have a direct relationship to the pathogenesis of rupture. The empty bladder is a pelvic organ and as such is well protected from external violence except as it may be involved in pelvic crushing. The full or distended bladder is an abdominal viscus and is exposed to external violence in the same manner as are the other abdominal organs. The vulnerability of the bladder, therefore is in direct ratio to its state of distention. It is seriously questioned by many whether the empty bladder is ever ruptured although all will grant the possibility of perforation by bony spicules, gunshot, etc.

Spontaneous bladder rupture has been reported by some. In three of our cases such an occurrence would seem likely although it must be remembered always that the distended and often diseased bladder may be ruptured by the slightest trauma. Many bladders in elderly patients show hyaline degeneration. Others are diseased by inflammation (tuberculosis ulceration) chronic distention with or without diverticulation (prostatic obstruction, urethral stricture spinal cord lesions) or neoplasm.

Although the trauma may be no more than a misstep with a slight fall or the exertion of getting out of bed (as in a case of ours) suprapubic kicks, blows, or crushing pelvic injuries are most commonly noted. Cases of bladder rupture during labor straining at stool, or lifting heavy weights have been observed by others.

Of the predisposing causes of vesical rupture in addition to distention alcoholism or other forms of mental irresponsibility are most important. A third (19) of our patients suffered vesical ruptures during a state of acute alcoholism many of these entered the hospital in alcoholic coma or delirium. As a corollary, a certain number are first seen in the psychopathic wards.

With the more general use of motor vehicles a third of the recently reported cases received their injuries in or by an automobile. Nine (16 per cent) of our patients were so injured. 8 of them were pedestrians. The remaining injuries may be classified as industrial and as such sustain an important medicolegal as well as scientific in-

<sup>1</sup>From the Urological First Second Third, and Fourth Surgical Services of Bellevue Hospital.

terest Twenty three or a trifle less than half of this series were industrial accidents—chiefly falls or pelvic crushings

Rupture followed a fall in eleven instances Apparently the distance fallen is of comparative unimportance, one patient who died fell but four feet Another, who lived fell eight stories Crushing injuries are perhaps more frequently observed In one of five (12) of this series bladder rupture resulted from this cause Further more, it should be noted that of the 55 cases here reported in 20 there was associated pelvic fracture Other causes of rupture given by these patients were exploding dynamo (1), kicked by a horse (2) severely beaten (1), and in one instance a postal clerk bumped himself suprapubically against the corner of a desk This accident resulted in a fatal vesical rupture In two instances there was associated prostatic obstruction with chronic vesical distention

Most writers on the subject leave one with the impression that with pelvic fractures injuries of the lower urinary tract are comparatively rare We studied 166 cases of fracture of the pelvis admitted to Bellevue Hospital from January, 1919, to January, 1928, and found that 25 (15 per cent) or one in every seven suffered also from vesical rupture In three others, rupture of the posterior urethra had occurred Furthermore, in many cases of fracture without demonstrable vesical rupture distressing urinary symptoms were present as follows acute retention (37), marked dysuria (5) and gross hæmaturia (36) Of 110 cases of pelvic fracture manifesting no urinary symptoms, 24 suffered fracture of the iliac bones lesions comparatively distant from the bladder It is evident therefore that a thorough examination for signs of urinary tract injury is strongly indicated in every case of fractured pelvis

#### SYMPTOMS

In most instances shock follows receipt of injury and we noted that on admission, a fourth of the 55 cases brought into Bellevue were in shock comatose or moribund Two died within 10 minutes after reaching the ward Marked cardiovascular depression is usually observed, pallor is extreme and the pulse is feeble or imperceptible Systolic blood pressure readings between 50 and 70 millimeters mercury are commonly recorded The general appearance and physical findings in many of these individuals strongly indicates internal hæmorrhage Urinary tract involvement is suggested by exquisite local bladder tenderness but perhaps more notably by dysuria, hæmaturia, or absolute inability to void

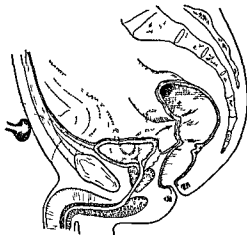


Fig 1 Mechanism of rupture in slightly filled bladder In these cases extraperitoneal rupture is said to occur more frequently (After Rouvillois and Ferron)

If intraperitoneal rupture has occurred the early symptoms of peritonitis may be present Abdominal tenderness and rigidity appear first, as the process progresses, nausea and vomiting may appear Gastro-intestinal disturbances are rare except in the presence of peritonitis

Oddly enough, this profound reaction does not ensue in all cases, certain patients are able to be up and about blissfully ignorant of their truly perilous state In one instance the patient was first seen in the psychopathic ward 9 days following rupture He had been drinking heavily for 2 weeks previous to hospital admission but he remembered quite clearly that 9 days before examination his greatly distended bladder was suddenly relieved without voiding when he attempted to get out of bed Laparotomy revealed an abdominal cavity flooded with urine and an associated peritonitis hastened death

Even more striking in this connection is the following history in which case the presence of vesical rupture was totally unsuspected and was disclosed only at autopsy

H C male aged 51 years, was admitted to one of the medical services of Bellevue Hospital complaining of slight swelling of the feet and general malaise His condition had been getting progressively worse during the past week There was neither history nor evidence of abdominal trauma and the patient was voiding normal quantities of urine with but slightly greater frequency than normal A diagnosis of cardiorenal disease was made and rest treatment instituted On the third day after admission evidence of considerable fluid in the abdominal cavity led to paracentesis at which time about 5 quarts of urinous appearing and smelling fluid was withdrawn This comment apparently made no impression for on the sixth and

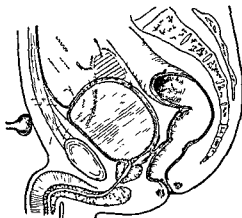


Fig 2 Mechanism of rupture when bladder is full and trauma of anteroposterior direction. Intrapertoneal rupture usually occurs (After Rouvillois and Ferron)

ninth days the procedure was repeated. On the eleventh day the patient died and autopsy revealed a rupture of the dome of the bladder with no evidence of local trauma. A low grade generalized peritonitis was found. The vesical outlet was not obstructed.

While this case might be recorded as an instance of spontaneous rupture, its greater interest lies not only in the moderation of symptoms in a surgical disease of unusually high mortality but in its *clinical deception*. Nowhere in many pages of bedside follow up notes, was a hint of the possibility of surgical urinary tract disease to be found.

#### DIAGNOSIS

A clear history is so often unobtainable and the clinical picture is so often that of extreme shock plus evident rupture of an abdominal viscus that the true diagnosis can be made only at operation. Rectal examination reveals little although it may indicate extravascular extravasation. Unless abdominal rigidity precludes a satisfactory examination, signs of free fluid in the abdomen indicate intraperitoneal rupture. In this series marked abdominal rigidity was found in 22 cases and unusual distention was seen in 31. Possibly this accounts for the fact that free fluid was demonstrated pre-operatively in but 7 cases. Extraperitoneal rupture was found in 21 patients whereas intraperitoneal rupture with free urine in the abdominal cavity was found in 34. The extreme condition of most of these cases when admitted to the hospital precludes protracted diagnostic efforts although there are certain tests and measures which may render positive diagnostic help.

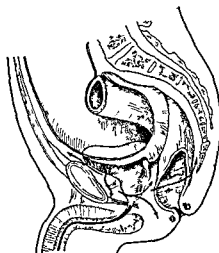


Fig 3 Course of extravasation in cases of extraperitoneal vesical laceration. Perirectal and retroperitoneal infiltration may be extreme (After Rouvillois and Ferron)

The most commonly employed and probably the most inaccurate of these tests is that of catheterization. Often there is no urinous return or a small amount of blood may be withdrawn. At times a large amount of urine will flow—far more than the apparently undistended bladder would suggest. This signifies drainage of a urine filled abdominal cavity. The injection of a measured amount of fluid and the estimation of its return should always be tried although several factors mitigate against the accuracy of this observation. Experience has shown that even in the presence of vesical rupture the same quantity of fluid may return. In one of our patients although the peritoneal cavity was flooded with urine, the small peritoneal tear over the bladder gave the appearance of fine lace work and permitted the urine to leak through but slowly. Moreover, plugging of the catheter by clots after injection has been made may prevent proper return flow. If the catheter has penetrated an abdominal pool of urine as often occurs, a far greater quantity of fluid will be withdrawn. Diagnostically this constitutes the most significant of any of these catheterization observations. Although the catheter test possesses many inaccuracies, we believe it is always worth performing constantly bearing in mind, however, that by this means a previously sterile peritoneal cavity may become infected. This method was used in 41 cases of this series but was of real diagnostic value in only 13. From nearly all cases bloody urine was withdrawn.

(which might indicate kidney trauma also), in most instances the withdrawal of a known injected quantity of fluid was unsuccessful because of catheter plugging with clots. In two instances, the catheter apparently drained a flooded peritoneal cavity.

When physical conditions will permit, cystoscopy is the most accurate method of diagnosis. However, vigorous and uncontrollable bleeding may render vision impossible or a large intraperitoneal rent may prohibit satisfactory bladder distention and thus prevent observation. We do not believe the added shock of cystoscopy is incompatible with sound surgical judgment but we do caution against prolonged cystoscopic sessions in these cases. A competent cystoscopist will know at once whether or not his instrument will be of use. In but six cases of this series was cystoscopy performed in but four could the bladder wall be seen. More of these patients were not cystoscoped because, with few exceptions, they were admitted to the general surgical services and exploratory operations were performed at once. Aside from the possibility of added surgical shock, the same objection holds for cystoscopic procedures as for other bladder instrumentations—the probable introduction of infection.

Four years ago Vaughn and Rednick introduced vesical pneumoradiography—a diagnostic measure of striking ingenuity and accuracy even though the four cases in which they reported its successful use died. Following the injection of 50 to 100 cubic centimeters of air into the bladder lateral abdominal roentgenograms are taken. If the bladder is ruptured intraperitoneally, the air is indicated within the abdominal cavity, it may localize just below the diaphragm. If the rupture is extraperitoneal, perivesical infiltration of air will be demonstrated. In some instances the air dissects under the fascial planes. Without rupture, a vesical pneumogram of normal contour will be obtained. We have never used the method. Because of the symptomatic similarity of intraperitoneal vesical rupture and rupture of other abdominal viscera, immediate surgical intervention is usually indicated, at which time the correct diagnosis will be made. Extraperitoneal rupture is manifested by perivesical extravasation which often can be clinically identified. In one such case, extravasation involved the tissues of the lower groin and upper thighs. In a case of spontaneous rupture recently seen marked perineal infiltration was observed.

Laboratory findings offer scant aid. Urinary changes other than hematuria are of no diagnostic value in these cases. The blood count

shows comparatively little alteration except in the event of hemorrhage or peritonitis. Hemorrhage is indicated, of course, by a low or falling red cell count and hemoglobin. White cell counts were done in 29 patients. Three showed a total count under 10,000, ten between 10,000 and 15,000, ten between 15,000 and 20,000, and six showed over 20,000. Polymorphonuclear differential count showed 5 under 80 per cent, 12 were 80 to 90 per cent, and 10 were over 90 per cent. Ninety five per cent of the high white cell and polymorphonuclear counts accompanied peritonitis.

We do not advise protracted waiting in hope that the general condition of the patient will improve. Combat of shock is best achieved by blood transfusion although the administration of heat to the body, stimulants, and large quantities of fluids may serve partially to revive some of these patients. As a rule, however, the clinical course is one of depression, the condition of the patient becomes rapidly and progressively worse. For this reason, early operation is advisable, at which time transfusion, intravenous saline or glucose solution may be given and with proper bladder drainage will do most to reduce the ultimate mortality.

#### TREATMENT

The diagnosis of ruptured bladder seeming likely, operation should be performed at once. Nitrous oxide oxygen or ethylene anesthesia is preferable in most instances although in a few cases of this series local infiltration was used. Spinal anesthesia is contra indicated in the presence of marked vascular depression with low blood pressure but was successfully employed in four cases. We do not, however, recommend spinal injection for surgical procedures in patients suffering profound shock.

In most cases intraperitoneal exploration is indicated. Several times at operation and at autopsy the abdominal cavity has been flooded with urine yet it has proved extremely difficult to find the true bladder rent. Operative speed is imperative. If no evidence of intraperitoneal urine is found the peritoneum is closed and the bladder interior investigated. If peritoneal involvement is found, such fluid as is readily obtained is aspirated and ample drains are left. We caution against flushing out the abdominal cavity with saline or medicated solutions as this procedure not only wastes valuable time but disseminates infection.

The vesicoperitoneal tear is hastily closed by a minimum of sutures firmly grasping the bladder musculature. It is unnecessary to attempt layer

TABLE I—AGE INCIDENCE IN YEARS

	Cases
Not stated	1
Under 10	3
10 to 19	3
20 to 29	7
30 to 39	16
40 to 49	12
50 to 59	11
60 to 69	2
Total	55

muscle suture of the bladder. Furthermore, it wastes time. Perivesical hæmatomata or extravasations should be amply drained.

Of greatest importance in the entire surgical procedure is the establishment of liberal supra pubic bladder drainage. We say this advisedly, having in mind some instances in which otherwise good general surgeons have attempted bladder drainage in these cases by means of rubber wick drains inserted through a small cystotomy opening. One must not hesitate to leave the bladder well open on the urological service we usually employ a three fourths inch tube for this purpose. With such free drainage bleeding and extravasation will cease at once and smaller unsutured bladder wounds will promptly heal. Penetrating wounds caused by the bony spicules of pelvic fracture are rarely large enough to require suture. Such bony spicules, stones, or other foreign bodies present in the bladder should be removed while the bladder is open.

The location of the vesical rupture modifies in some instances the procedure employed. Involvement of the vesical outlet may include the posterior urethra and in these cases perineal as well as intrapelvic hæmatoma or extravasation are commonly observed. In addition to ample perineal incision and bladder drainage we believe supra pubic drainage should also be instituted. Correction of the urethral obstruction can wisely be left for a more propitious time, since extensive and prolonged initial surgical procedures are strongly contra indicated. One may profitably bear in mind that several cases are on record in which intraperitoneal rupture has been successfully treated by ample bladder drainage alone.

Drainage by external urethrotomy only is ill advised treatment for bladder rupture. None of the four cases of this series treated by this method survived. In two other cases, perineal drainage supplemented cystotomy. Laparotomy was performed in 29 patients, cystotomy alone was done in 12, and in 10 cases no operation was possible.

The bacterial content of the urine determines in a large measure the ultimate outcome. The

intraperitoneal injection of sterile urine will not cause peritonitis. Unfortunately, the urine of most of these patients is already infected or has become infected by instrumentation. The incidence of peritonitis, therefore, is high. In 23 of the 32 cases of intraperitoneal rupture, there was demonstrable peritonitis. Early intervention in the remaining cases probably accounts for the lack of gross evidence of this complication.

#### SURGICAL PATHOLOGY

If extraperitoneal extravasation has occurred, skin incision reveals a marked urinary cedematous infiltration of the perivesical tissues and the abdominal musculature. These structures are soggy, dead looking, grayish, or grayish red in appearance and may contain localized abscesses. Crepus results from gas bacillus infection (usually other than bacillus welchii) and may often be elicited over a widespread area. In one case of ours the pelvis and lower groins were thus involved. In another instance autopsy revealed extravasation extending along the spermatic cord on each side to the scrotum.

Most ruptures are found on or near the dome of the bladder. Unusually long or multiple rents may offer both intraperitoneal and extraperitoneal urinary egress. While the transverse seems to be the commonest direction taken by these wounds, they may follow courses which are oblique or anteroposterior or may be bizarre modifications of T, Y, U etc. A few ruptures occur at the bladder outlet and on the bladder floor and are most apt, as previously indicated, to give rise to perineal or subvesical hæmatomata and urinary extravasation. In one case coming to autopsy, retroperitoneal extravasation had ascended to the level of the kidneys. In this series the location of the rupture was recorded as follows: dome (anterior or posterior), 37, lateral wall, 4, floor, 3, vesical outlet, 4, posterior wall, 1.

In one of our patients rupture of a diverticulum occurred and in such previously diseased bladders the co-existing pathological conditions—ulceration, tuberculosis, neoplasia, or degeneration—will be disclosed at operation. In but two of our cases was chronic vesical distention proved to be due to prostatic enlargement.

#### COMPLICATIONS

It is the complications induced by vesical rupture which kill. These complications are immediate or late. Shock or hæmorrhage may be extreme and quite promptly fatal. If the patient survives this initial period extravasation and sepsis usually develop. If these are to prove fa-

TABLE II—TREATMENT, MORTALITY

	Extra peritoneal	Intra peritoneal	Total
Total cases	21	34	55
Not operated upon	1	9	10
Total died	9	26	35
Operative	20	25	45
Operative died	8	17	25
Operative mortality percentage	40	68	55.5
Total mortality percentage	42.9	73.5	63.6

TABLE III—FATAL OPERATIVE CASES, INTERVAL BETWEEN INJURY AND OPERATION

	Intra peritoneal	Extra peritoneal
Less than 3 hours	1	4
Less than 6 hours	7	2
Less than 12 hours	4	
12 to 48 hours	1	
3 to 5 days	1	
6 to 10 days	1	1
Unknown (not stated)	2	1
	17	

tal death ensues in most cases within one week. As indicated peritonitis may be anticipated in approximately half of all cases. Associated rupture of abdominal viscera occasionally occurs and may likewise prove fatal. In this series splenic rupture was observed once and the intestines were ruptured in three cases. That death does not always follow such wounds is demonstrated by the fact that two of these patients lived following intestinal suture, there being two intestinal wounds in one case. At autopsy we have seen both liver and kidney rupture associated with vesical rupture and in this connection it is well to point out that a history of vesical injury plus the observation of a brisk hæmaturia does not rule out renal injury nor the possible renal origin of the blood. Observation of bloody ureteral ejaculation will give the clue.

Although fracture of the bony pelvis is often a serious immediate complication, subsequent acute osteomyelitis may prove fatal as in two patients of this series. One of these had received nine transfusions in an unsuccessful attempt to combat the sepsis of osteomyelitis, finally dying 8 months after the receipt of injury. In a patient observed recently, osteomyelitis of perivesical bony spicules gave rise to an abscess 6 months after pelvic fracture and vesical rupture. Incision and drainage with bony spicule removal was successfully performed. Following the initial operation vesical fistulæ may be persistent and require resection as in two of our cases. One patient was in a plaster cast with suprapubic drainage for 6 months before the repair of a stenosed ruptured prostatic urethra and bladder neck could be undertaken. Late urethral resection for traumatic stricture was performed once.

Acute evisceration occurred in two patients shortly after operation. In the first, the wound was torn open on the second day by the patient's own hands. In the second case an attempt to get out of bed on the sixth day after operation brought on the condition. In both cases intestinal evisceration occurred and as is the rule in such accidents immediate abdominal closure proved hopeless.

Other complications delaying convalescence or causing death were fractures of the leg (4), arms (2), amputation of arm for gangrene following fracture (1). An abscess of the groin and of the buttocks each required incision and drainage. Gas gangrene of the pelvis and lower groins occurred once.

#### PROGNOSIS AND MORTALITY

Of the 20 patients who survived (all of whom were operated upon), 5 were able to leave the hospital in less than 3 weeks, 6 left in 3 to 6 weeks, 5 in 6 to 12 weeks, and 4 remained in the hospital over 3 months. The longest stay was 6 months.

Of the 35 patients who died (10 of whom were not operated upon), 2 lived less than 10 minutes after hospital admission. Ten died within the first 24 hours, 14 more within 3 days, and all but 4 died in less than 1 week. One lived 8 months and died of osteomyelitis sepsis. From these observations we may deduce that if the patient survives the first week, a fair prognosis is rendered likely.

In all cases a grave prognosis is warranted during the first week since the mortality is unusually high. A summary of case reports by others indicates that 60 to 80 per cent of these patients die even under the most favorable of surgical conditions. In this series 35 died, a mortality of 63.6 per cent or two thirds. It is interesting to note that of those patients suffering intraperitoneal involvement 73.5 per cent (26) died and what one might expect but 42.9 per cent (9) of those with extraperitoneal involvement died. The operative mortality of the extraperitoneal group was 40 per cent, of the intraperitoneal group, 68 per cent.

The surgical outcome depends on many factors, however, the outstanding of which are the age of the patient, the degree of shock, the extent and character of the injury, the bacterial content of the urine, and the rapidity with which surgical treatment is instituted and carried out. The liberal employment of transfusion is together with



the establishment of free drainage to the bladder and sites of extravasation our greatest hope in the lowering of the mortality following vesical rupture

#### CONCLUSIONS

Bladder rupture is of comparatively rare incidence is due to trauma, and is favored by vesical distention, alcoholism and pre existing disease of the vesical walls. The diagnosis is not easy to

make in most instances and early and speedy surgical operative treatment is imperative. Without the establishment of free bladder drainage any operative procedure will be of no benefit to the patient. Two thirds of these patients die. If intraperitoneal rupture has not occurred the prognosis is twice as good as when such rupture does occur. If the patient survives the first week his chances of recovery are greatly enhanced.

## CORPOREAL AND CERVICAL CÆSAREAN SECTION

## A COMPARATIVE ANALYSIS OF RESULTS ON A TEACHING SERVICE

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IN view of the present great interest in the cervical cæsarean section as a means of reducing maternal mortality in section done after the onset of labor, a review of our experience at the University of Pennsylvania was recently undertaken. The results of this survey may be of general interest for several reasons. In the first place, while the service commands only a small number of deliveries, it is one in which a wide variety of obstetric risks and complications are represented, entailing a high incidence of obstetric surgery of an emergency character. Second, the cervical cæsarean section has been employed in certain cases by six different staff members for the past 6 years, thus indicating a reasonable familiarity with its technique. Third, the clinic has maintained first under the aegis of Professor Barton Cooke Hirst and more lately under one of us, a neutral attitude with respect to the cervical operation, neither advocating nor imposing any given course upon the several surgeons until sufficient experience should warrant an audit of results, if possible upon the basis of a comparable number of cervical and corporeal operations performed coincidentally for similar indications. Fourth, the clinic has had a unique experience with a variation of the classic or conservative operation devised by the senior author, and voluntarily employed by all surgeons on the service in every case where a fundal approach has been chosen. Finally, the service still retains general anesthesia for major operations (principally from considerations having to do with the teaching of large groups of students)—a practice which is perhaps still the general one in this regard, therefore making our figures of value to a large audience.

Aside from our interest in the general questions of mortality and morbidity, the chief object of the survey was to determine whether the cervical cæsarean section should displace the conservative operation, either after the onset of labor alone or as a routine method of abdominal delivery.

## MATERIAL

In beginning the study it was noted that a review of the last 30 months would provide not only equal periods of 15 months under two depart-

mental heads, but also 73 consecutive cæsarean sections comprising comparable numbers of the classic or corporeal and the cervical operation done under approximately similar indications. At the same time, the selection of the most recent cases would exclude the earlier years when our initial results with the cervical operation might be open to criticism owing to inexperience with its technique.

Tables I to IV illustrate the type of maternal and problems encountered by the clinic, as also something of its methods. About 80 per cent of patients are charity cases and nearly 30 per cent are colored. Between 10 and 20 per cent of delivered cases are admitted to the hospital as labor emergencies without prenatal supervision by the service. It would be only fair to add, however, that among over 200 such dystocias in the 300 months covered by this survey, there were no instances of ill-advised attempts at operative delivery prior to admission—a gratifying reflection upon the disappearance of a kind of emergency which was comparatively frequent in the clinic's earlier years. By the same token the records disclose no instance of embryotomy having been done during an even longer period, though this fact is also partly accounted for by our readier resort to section in the interest of the child in the face of risks formerly deemed prohibitive.

## CONSIDERATION OF TECHNIQUE

*Corporeal cæsarean section.* The conservative sections in this series were mostly done according to a technique evolved several years ago by the senior author and adopted individually since that time by all members of the service. The principal features of this technique are illustrated in Figures 2 to 6. Aside from locating the uterine incision low on the anterior wall as suggested by the late Professor Studdiford, the method consists principally of meticulous care in coaptation and suture as first emphasized by Saenger. To this is added the adoption of the surgical principle of carefully burying all sutures, we aim by this peritonealization to secure a wound which shall be sealed and leak-proof within a few hours after operation and shall remain so in spite of the after contractions of the uterus.

TABLE I—INCIDENCE OF CÆSAREAN SECTION

Period of thirty months from April 1 1916 to September 30 1918

According to	Deliveries			Cæsa- rean sec- tions	Incidence
	White 1917	Black 1917	Total 3583		
1 Total service deliveries				73	1 in 54.6
South Eastern Dispensary (home deliveries)	1128	1662	2790		
Hospital deliveries	860	379	1239		
2 Sources of 1918 hospital deliveries					
Hospital/Frenetel Clinic	770			31	1 in 22.0
Staff (Private cases)	248			17	1 in 14.9
Outside physicians†	101			13	1 in 8.3
South Eastern Dispensary†	109			0	
Accident Ward	30			0	
3 Certain complications among 1918 hospital deliveries					
Contracted pelvis	96			38	1 in 2.5†
Placenta previa and abortion	40			4	1 in 12.2
Cardiac disease	13			1	1 in 13.0
Previous cæsa- rean sec- tion	37			24	1 in 1.3
4 Parity of 1918 hospital deliveries					
Primigravidae	389			25	1 in 15.6
Multigravidae	860			48	1 in 18.0

Home delivery service, situated in another section of the city and having its own prenatal clinic. Service under supervision of the professor of obstetrics, and deliveries conducted by senior students of the University Medical School. All major complications are referred to the University Hospital.

†Refers only to cases admitted in labor as emergencies or without prenatal supervision by the department.

‡High incidence of section in contracted pelvis explained by the fact that 14 of the major contractions and failed test labors arising on the South Eastern service come to hospital.

The low position of the uterine wound makes the extraction of the fetus a trifle more difficult than when the incision is made in the fundus proper, care to secure both feet of the child however and to extract by a deliberate internal version, insures against tearing or extending the wound. The advantages of this site are that it keeps contamination of the peritoneum confined principally to the pelvis, and, since the peritoneal coat of the fundus is loosely invested at this level renders the application of a Lembert sero-serous stitch practicable. The operator must be prepared to take pains in the introduction of the latter stitch and to employ small "bites" of the needle. While the method is time consuming and perhaps tedious, we have found that the extra minutes and effort are well worth while even in operations of an emergency character. The smoother convalescence freedom from tympanites and greater safety secured by its use are in distinct contrast to our previous experience and more than counterbalance the slightly higher immediate febrile reaction incident to long operative time and the burial of a large amount of catgut.

*Cervical cæsa-  
rean section.* The cervical operations in this series were about equally divided be-

TABLE II—TYPES OF CÆSAREAN SECTION PERFORMED

	Emer- gency	Elective	Total
Fundal sections	20	24	44
High (classic)	9	10	19
Low	11	14	25
Cervical sections	24	11	35
Beck	6	3	9
Kerr	0	8	8
Other types	1	2	3
Marxupulston	1		1
Porro	1		1
Total	35	37	72
Coincidental operative procedures in 74 cases			
Sterilization (tubal)			8
Appendectomy			1
Mymectomy			1
Ovarian cystectomy			1
Herniorrhaphy			1
Appendectomy herniorrhaphy sterilization			1
Average operative time in minutes in remaining sections (6 surgeons)			
Fundal			33
Cervical			25
Other types			23

TABLE III—REPEATED CÆSAREAN SECTION

No previous cæsa- rean sections	40
One previous cæsa- rean section	1
Two previous cæsa- rean sections	5
Three previous cæsa- rean sections	2

tween Kroenig or longitudinal, and the Kerr transverse or elliptical incision. The technical features of these operations are well known and are not particularly formidable for a practiced abdominal surgeon. The following comments need to be mentioned, however, in view of the current tendency of enthusiasts to minimize the risks. The cervical section is usually said to be most readily done after the onset of labor, when the lower uterine segment has become extended and thinned out. This is true for as long as the membranes remain intact and provided the head has not been allowed to mold excessively in protracted efforts to secure engagement. Under the latter circumstances which would probably not obtain in test labor conducted in a well organized clinic but which nevertheless are frequently the conditions under which emergencies reach the occasional operator, the extraction of the fetal head, deeply placed behind an overstretched bladder and tightly pressed against the pelvic brim by a molded uterus, is a matter calling for the utmost in obstetric and surgical skill. The penalties are tears of the uterus and injuries to the bladder. The above is particularly true of the Kerr operation unless the transverse uterine incision is kept low enough to lie over the prominence of the fetal head. Disregarding this, the inexperienced surgeon will be chagrined to find a shoulder or arm prolapsing through the wound, and an extension

TABLE IV—INDICATIONS FOR CÆSAREAN SECTION

	Emergency			Elective			Total
	Corpo- real	Cervi- cal	Other	Corpo- real	Cervi- cal	Other	
Contracted pelvis group							
Dystocia							14
Dystocia only	6	8	1				2
Plus previous cesarean		1	1				1
Plus eclampsia		1					
Pregnancy contracted pelvis				4			4
disproportion							
Pregnancy contracted pelvis							
disproportion previous cæsa-				10	6		16
rean section							
Contracted pelvis and placenta							
previa	1						1
Total contracted pelvis			18		20		38
Other Indications group							
Dystocia							6
Due to disproportion	3	1					1
Same plus previous cesarean		1					1
Cervical dystocia elderly							
primigravida		1	2				3
Cervical dystocia from pre-							
vious operation			1				1
Sacculat on due to previous							
operation	1						1
Sacculat on from previous							
cesarean	1						1
Intrapartum hemorrhage							
(abruptio)	1						1
Primary inertia pulmonary							
tuberculosis							1
Previous dystocia							
Previous dystocia only					2		1
Same resulting in stillbirths							
Same with previous cesare-							
ans				3	1		4
Acc deaths of pregnancy							
Placenta previa	1						1
Ab ruptio placente	1						1
Incidental complications of							
pregnancy							
Pulmonary tuberculosis				1			1
Cardiac disease				1			1
Ovarian cyst							
Myoma uteri					2		2
Intestinal obstruction	1						1
Miscellaneous							
Sacculat on previous ventro-							
fixation				1			1
Sacculat on previous inter-							
position					1		1
Hi bot al death of fetus							1
Disproportion only				1			1
Total 1 Other Indications			18		17		35
			36		37		73

\*Of 32 operations for dystocia 23 were strictly emergency, and 10 were so classified after a test 1 b0 conducted or completed in hospital

of the wound made necessary before the child can be delivered

On the other hand when the cervical section is performed before the onset of labor the lower uterine segment is frequently thick and the source of troublesome hæmorrhage in some cases. The incision being in a non contractile portion of the uterus, moreover, a tendency to atonic hæmorrhage will be present when general anæsthesia is used a complication which the mere introduction of sutures will not counteract as it appears to do when the incision is in the more irritable musculature of the corpus

While our experience with the cervical section in placenta previa is too limited to justify a comment initial trials and a consideration of certain

TABLE V—MATERNAL AND INFANT MORTALITY

	Emergency			Elective			Total
	Corpo- real	Cervi- cal	Other	Corpo- real	Cervi- cal	Other	
Total operations	20	14	2	24	11	2	73
Maternal mortality	1	1		1			3
Shock		1					
Postoperative hæmorrhage	1						
Penttonitis							
Infant Mortality	4	5	1	1	1		12
Stillbirths							
Cerebral hæmorrhage		1	1				
Placenta previa	1						
Abruptio placente	1						
Neonatal deaths							
Cerebral hæmorrhage		3					
Prematurity	1	1		1	1		
Congenital adenoma thyro d							

Deaths occurring up to 2 weeks postpartum

obvious facts lead us to believe that the propriety of the procedure is by no means the ideal one claimed in some quarters, particularly if the surgeon be unprepared for the possible consequences

It is perhaps obvious but appropriate to add that certain cases in which suspending adhesions from a former operation have kept the anterior uterine wall thickened (while sacculat on of the posterior wall occurs) are also technically unsuited for the cervical section

#### MORTALITY

There were three maternal deaths in the series one from penttonitis (Table V) All occurred before the fourth day and are charged in review to 'errors of judgment' in spite of two of the patients having been admitted as emergencies in precarious condition, since the series includes a number of comparable emergencies more happily managed. The mortality figures furnish no basis of comparison between the types of cæsaean section, since in every fatal instance the operation was ill chosen for the problem in hand

#### MATERNAL MORTALITY

CASE 4362 Patient aged 27 years v para with just-minor pelvis. Previous deliveries had been terminated by forceps. Ventrosuspension had been done after last child birth. She was referred to the hospital in *extremis* after 36 hours active labor at term and an impacted mento posterior position. She had been seen on the home delivery service and was twice urged to come to hospital refusing which she had signed a release. Finally her people appealing to the hospital she was admitted in a state of shock but with the fetus still alive. An emergency cervical section was performed which was technically complicated by adhesions formed after the previous operation. She failed to rally from shock and died 4 hours after operation. Error in judgment

CASE 5071 Patient aged 40 years vii para. Previous deliveries had been spontaneous. Following last child birth she had a modified interposition operation which

TABLE I—INCIDENCE OF CÆSAREAN SECTION

Period of thirty months from April 1, 1926 to September 30, 1928

According to	Deliveries			Cæsarean sections	Incidence
	White	Blk	Total		
1 Total service deliveries	1997	991	3088	73	1 in 54.6
South Eastern Dispensary (home deliveries)	113	1662	1775		
Hospital deliveries	869	320	1189		1 in 16.4
2 Sources of 1928 hospital deliveries					
Hospital Prenatal Clinic	710			31	1 in 22.9
Staff (Private cases)	248			22	1 in 11.9
Outside physicians	101			12	1 in 8.3
South Eastern Dispensary	109			9	1 in 12.2
Accident Ward	30			0	
3 Certain complications among 1928 hospital deliveries					
Contracted pelvis	96			38	1 in 2.5
Placenta prævia and abruptio	49			4	1 in 12.2
Cardiac disease	13			1	1 in 13.0
Previous cæsarean section	31			24	1 in 1.3
4 Partly of 1928 hospital deliveries					
Premigravida	389			25	1 in 15.6
Multigravida	809			48	1 in 16.9

Home delivery service, situated in another section of the city and having its own prenatal clinic. Service under supervision of the professor of obstetrics, and deliveries conducted by senior students of the University Medical School. All major complications are referred to the University Hospital.

†Refers only to cases admitted in labor as emergencies or without prenatal supervision by the department.

High incidence of section in contracted pelvis explained by the fact that 60% of the major contractions and failed test labors arising on the South Eastern service come to hospital.

The low position of the uterine wound makes the extraction of the fetus a trifle more difficult than when the incision is made in the fundus proper care to secure both feet of the child, however, and to extract by a deliberate internal version insures against tearing or extending the wound. The advantages of this site are that it keeps contamination of the peritoneum confined principally to the pelvis and, since the peritoneal coat of the fundus is loosely invested at this level renders the application of a Lembert sero-serous stitch practicable. The operator must be prepared to take pains in the introduction of the latter stitch and to employ small "bites" of the needle. While the method is time consuming and perhaps tedious we have found that the extra minutes and effort are well worth while even in operations of an emergency character. The smoother convalescence freedom from tympanites, and greater safety secured by its use are in distinct contrast to our previous experience and more than counterbalance the slightly higher immediate febrile reaction incident to long operative time and the burial of a large amount of catgut.

**Cervical cæsarean section.** The cervical operations in this series were about equally divided be-

TABLE II—TYPES OF CÆSAREAN SECTION PERFORMED

	Emergency	Elective	Total
Fundal sections	30	24	44
High (classic)	9	10	
Low	11	14	
Cervical sections	14	11	25
Rock	8	3	
Kerr	6	8	
Other types	2	2	4
Marshallization	2		
Porro		2	
Total	56	37	73
Coincidental operative procedures in 14 cases			
Sterilization (tubal)			3
Appendectomy			2
Myomectomy			1
Ovarian cystectomy			2
Herniorrhaphy			1
Appendectomy herniorrhaphy sterilization			1
Average operative time in minutes in remaining sections (6 surgical)			
Fundal			51
Cervical			58
Other types			83

TABLE III—REPEATED CÆSAREAN SECTION

No previous cæsarean sections	49
One previous cæsarean section	7
Two previous cæsarean sections	5
Three previous cæsarean sections	2

tween Kroenig or longitudinal, and the Kerr transverse or elliptical incision. The technical features of these operations are well known and are not particularly formidable for a practiced abdominal surgeon. The following comments need to be mentioned, however, in view of the current tendency of enthusiasts to minimize the risks. The cervical section is usually said to be most readily done after the onset of labor, when the lower uterine segment has become extended and thinned out. This is true for as long as the membranes remain intact and provided the head has not been allowed to mold excessively in protracted efforts to secure engagement. Under the latter circumstances, which would probably not obtain in test labor conducted in a well organized clinic but which nevertheless are frequently the conditions under which emergencies reach the occasional operator, the extraction of the fetal head, deeply placed behind an overstretched bladder and tightly pressed against the pelvic brim by a molded uterus, is a matter calling for the utmost in obstetric and surgical skill. The penalties are tears of the uterus and injuries to the bladder. The above is particularly true of the Kerr operation unless the transverse uterine incision is kept low enough to lie over the prominence of the fetal head. Disregarding this the inexperienced surgeon will be chagrined to find a shoulder or arm prolapsing through the wound, and an extension

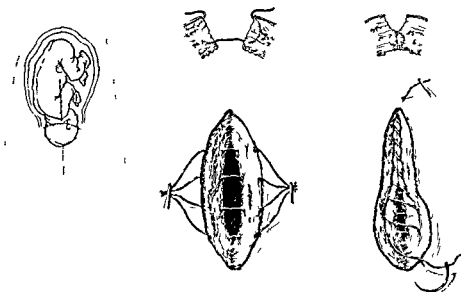


Fig 1

Fig 2

Fig 3

Fig 1 Location of incisions. The abdominal incision is made entirely below the umbilicus. The uterus is opened by a midline incision beginning just above the bladder reflexion thus exposing the fetal shoulder. In order to extract the fetus without extending or tearing the uterine wound it is necessary to grasp both feet and deliver by a careful internal version.

Fig 2 Uterine closure. Tension sutures of No. 2 to 20 day chromic gut take in the entire myometrium avoiding the decidua. The free ends are brought out beneath the perimetrium.

Fig 3 First tier. Continuous suture of No. 10 day chromic gut takes in the deeper half of muscle avoiding decidua. Tension sutures not illustrated here.

intrapartum eclampsia. The fetus was doubtfully viable. An emergency Beck section was done for disproportion after failure of test forceps. Diagnosis cerebral hemorrhage. Weight 3900 grams.

CASE 5131 (see Maternal Mortality). Emergency section was done in the interest of the mother. The fetus was macerated. Diagnosis asphyxia abruptio. Weight 2034 grams.

CASE 6106 Patient aged 27 years 1 para with normal pelvis suffered from toxæmia and abruptio placenta in the thirty eighth week and failed to deliver after metruorrhæa and 22 hours of test labor. Membranes ruptured after 8 hours. Emergency low fundal section was done in the interest of the mother (continued uncontrolled hemorrhage and fear of uterine gangrene). Diagnosis intrapartum asphyxia abruptio. Weight 2700 grams.

#### NEONATAL DEATHS

CASE 4015 Patient aged 32 years 11 para. Elective high fundal section was done in the interest of the mother in the thirty first week. Pressure symptoms were present due to the presence of a rapidly growing ovarian cyst the size of a six months pregnancy. Death occurred on the second day. Diagnosis prematurity.

CASE 4362 (see Maternal Mortality). An emergency Beck operation was done in the interest of the child. Death occurred on the second day. Diagnosis cerebral hemorrhage.

CASE 4508 Patient aged 16 nullipara with just minor pelvis. A Beck section was done at term after 20 hours of test labor obstructed by disproportion. Death took place on same day. Diagnosis cerebral hemorrhage.

CASE 4530 Patient aged 21 years 1 para with flat pelvis. Previous forceps delivery and stillbirth. After test labor of 95 hours at the thirty eighth week characterized by irregular pains and premature rupture of membranes the head remained floating. A Beck section was done. Death occurred in 2 hours from suffocation due to tracheal pressure from the large fetal adenoma of the thyroid. Post mortem pathological diagnosis fetal adenoma. Weight 3255 grams.

CASE 5071 (see Maternal Mortality). Elective Kerr section was done in interest of mother. Death occurred on the same day. Diagnosis prematurity.

CASE 5180 Patient aged 38 years nullipara with normal pelvis suffered from late toxæmia. Patient failed to deliver after 24 hours test labor at term. Membranes ruptured in 5 hours. A Kerr section was done in the interest of the child and for cervical dystocia in elderly primigravida. Death occurred on same day. Diagnosis cerebral hemorrhage.

CASE 5665 Patient aged 30 years nullipara. Emergency admission made in thirty third week for acute intestinal obstruction from adhesions following previous ovarian cystectomy. A low fundal section was done and it was necessary to empty the uterus in order to release the obstruction. Death occurred on second day. Diagnosis prematurity. Weight 2135 grams.

#### MORBIDITY

While the small size of this series prevents any sweeping deductions and renders futile any effort to cast percentages, a close study of Tables VI

TABLE VI—MORBIDITY

	Emergency			Elective		
	Cor pora	Cer vical	Other	Cor pora	Cer vical	Other
Total operations	20	14	2	24	11	2
Febrie first 3 days	17	11	0	15	10	1
Febrie after third day	16	10	0	6	8	1
Endometritis and sapre- mia	10	5		4	3	
Pyelocystitis					1	
Pelvic abscess	4	1		1	3	
Mastitis (non suppu- rative)	2	1		1		
Pneumonia		1				
Bronchopneumonia	1					
Pulmonary tuberculosis		1				
Pleurisy						1
Hypodermic abscess		1				
Postoperative tympanites						
Noted as present or absent	14	9	1	18	6	0
Mild	5	3		5	1	
Moderate	4	3	1	6	3	
Marked	2	2		1	1	
Wound Complications						
Type A	2			1		
Type B	1	1				
Type C						
Average post-operative days	20.7	18.0	16.5	17.0	16.2	19.5

A temperature of 101 degrees F twice in 24 hours, exclusive of the first 24, the temperature being recorded every fourth hour.

(In none of these was the lesion serious nor the blood cultures positive.)

(Present before operation.)

(Classification of the Woman's Hospital in New York. All actual wound infections, major or minor, fall under Type C.)

resulted during this pregnancy in posterior sacculation of the fundus. And symptoms serious enough to confine her to bed for 2 months prior to admission in the thirty third week of pregnancy. Her condition was further complicated by an imperfectly controlled diabetes mellitus. Elective cervical section for relief of symptoms found the uterus anchored behind the bladder with full thickness of musculature intact. There was profuse hemorrhage. Patient died of general peritonitis on the fourth day. Error in judgment.

CASE 5132 Patient aged 28 years, 1 para, suffered from late toxemia. Abruptio of the placenta occurred in the thirty eighth week of pregnancy. Patient was admitted to the hospital in shock, fully 31 hours later. Emergency (fundal) section was chosen because of the absence of cervical dilatation and the presumptive loss of integrity of the musculature of the uterus. The uterus was found undoubtedly gangrenous but owing to the patient's lack of fever (shock?) and the clinic's previous favorable experience with conservative operation in these cases a contemplated Porro operation was not carried out. With transfusion the patient reacted promptly after operation. She collapsed suddenly within a few hours of operation and died shortly thereafter. Postmortem examination revealed postoperative intraperitoneal hemorrhage apparently from seepage through the uterine wound and the fallopian tubes. Error in judgment.

To attempt to divide the fetal mortality by type of operation would likewise lead nowhere, as would any attempt to establish the percentage of fetal mortality for cesarean section in general in so small a series. The figures are elaborated in the appended case abstracts for the perusal of stu-

TABLE VII—MORBIDITY OF CASES OPERATED ON FOR DYSTOCIA ONLY

	Corporel	Cervical
Total operations	16	14
After test labor conducted or completed in hospital	11	8
Emergency operation on admission	5	6
Pre-operative data		
Average hours of labor pre-operative	29.2	31.0
Number cases of ruptured membranes	4	1
Average hours membranes ruptured	24.1	21.8
Average temperature pre-operative	99.1	99.1
Attempts vaginal delivery	1	4
(All conducted in hospital; all using all needed forceps and one bag line.)		
Average number of vaginal examinations		
None	3	1
One	4	3
Two to four	5	7
More than four	4	3
Febrie first 3 days	14	11
Febrie after third day	14	10
Endometritis and sapremia	10	5
Pyelocystitis	3	1
Mastitis		1
Pulmonary acute	1	1
Pulmonary tuberculous		1
Hypodermic abscess		1
Postoperative tympanites—notation		
Absent	13	9
Mild	3	1
Moderate	3	3
Marked	2	1
Wound complications		
Type A	1	0
Type B	1	1
Type C	0	0
Average post-operative days	21	19

dents of mortality. When these are closely examined the data will be informative principally of the risks to the child in cesarean section when the same is performed as an alternative to embryotomy in doubtful cases. This is apparent in the mortalities listed under placental accidents, and especially in the neonatal deaths from cerebral hemorrhage.

## STILLBIRTHS

CASE 4117 Patient aged 36 years, 1 para, with just-minor pelvis had been delivered four times by means of forceps and twice by cesarean section. Emergency admission to hospital took place after 50 hours in labor at term. 48 hours after rupture of the membranes. The fetus was dead when patient entered the hospital but the condition of the cervix made craniotomy impossible. Marsupialization section was done. Diagnosis: cerebral hemorrhage. Weight 2331 grams.

CASE 4639 Patient aged 21 years, 1 para, with just-minor pelvis. Previous delivery had been done by means of forceps stillbirth. Emergency admission for placenta previa took place in thirty-eighth week of pregnancy. The cervix was closed. The fetus was doubtfully viable. Emergency classic section was done in the interest of the child. Diagnosis: asphyxia, placenta previa. Weight 3020 grams.

CASE 4951 Patient aged 28 years, nullipara, with just-minor pelvis. Emergency admission to hospital took place after 96 hours of dry labor at term, and supervening

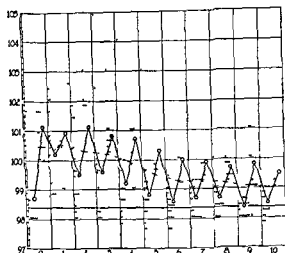


Chart 1 Extreme diurnal variations and average daily temperature after operation in 16 emergency (dystocia) fundal sections

New York revealed no major complications and no infections save in the fatal case referred to. None of the cases remained hospitalized for wound complications beyond the allotted time, and to date a re-examination of cases in the follow up clinic has failed to discover any late defects.

Table VII recasts the febrile morbidity for cesarean section when performed after the onset of labor. It is this group of cases which defines the acid test of safety for any given type of cesarean section. The pre-operative conditions obtaining in the present series show an average of approximately 30 hours of labor in 32 total operations for dystocia, 30 of which were done by either the corporeal or cervical method and the remaining two by marsupialization or extra-peritoneal operations chosen as alternatives to hysterectomy in cases of frank pre-operative infection. It is significant of the clinic's experience and methods to note that in the period represented by this report there was no resort to hysterectomy at any time because of presumptive ante-partum uterine infection, although the pre-operative temperature ascribable to such infection alone reached peaks of over 100.6 (in two cases 101.6) degrees in 5 of the 30 cases of Table VII, and the length of time the membranes were ruptured exceeded 48 hours in 3 cases. Eleven of the 30 cases were frank emergencies and, in the remaining test labors, an additional 9 had been in labor for varying intervals under other supervision before admission to the hospital. As pre-

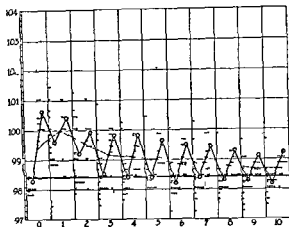


Chart 2 Extreme diurnal variations and average daily temperature after operation in 24 elective fundal sections

viously noted, however, the only attempts at vaginal delivery prior to operation, 5 in number, were conducted in hospital. Since the choice of operation in 30 of the 32 total operations for dystocia lay between the cervical and corporeal routes the data are classified in Table VII to show the conditions and results under these two procedures. It is when so considered that the slight superiority of the cervical type of approach in these cases is demonstrated. While there was one mortality in the cervical group and none in the other, the results in the various morbidity factors were somewhat better for this operation than for the corporeal, in spite of a generally less favorable class of risk beforehand.

Perhaps the morbidity of recovery is more strikingly illustrated in the graphic temperature records. These were constructed to show the average pre-operative temperature, the average peak temperature at the end of each 12-hour post-operative period to the beginning of the second day, and thereafter the average low and average high temperature for each day up to the tenth. Differences here tend to iron out so consistently in such an averaging of data that the seemingly minor differences in the averaged totals are more significant than would at first appear to be the case. The charts may be read in a number of ways, one of which is to note the date at which the average temperature for the day falls below 99 degrees. The better records are naturally in the elective groups, as compared to the dystocia groups. On the other hand, within the elective groups alone, the records of the conservative operations are superior to those of the cervical and constitute the best convalescences of the



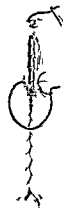


Fig. 4

Fig. 5

Fig. 6

Fig. 4 Second tier The same suture as in Figure 3 returning takes in the superficial half of the muscle The tension sutures of Figure 2 are tied at the completion of this stitch

Fig. 5 Third tier Continuous subcuticular stitch No. 0 20 day chromic gut for apposition of superficial wound edges

Fig. 6 Fourth tier Opposite end of suture shown in Figure 5 threaded upon a fine intestinal needle for peritonealization of wound Small bites close to wound edges are needed in upper third

and VII and of the corresponding graphic temperature charts will yield information not only concerning the morbidity of section in general, but also something about the comparative results of corporeal and cervical operations

A consideration of morbidity takes in a number of factors which the temperature alone cannot possibly represent, such as nausea tympanites, anæmia wound and other complications pelvic adhesions effect upon lactation effect upon future childbirth, and the like Furthermore, the temperature charts of different clinics can find no common basis for the comparison or lumping of experience so long as conditions vary so widely locally On the other hand it is conceded that while the febrile record gives only a partial and in some instances an erroneous view of a case it is at least a fair index of recovery the patient febrile from one complication will often run the gamut of other morbidities

We, therefore follow the conventional method with a protest, however, against applying a morbidity measure designed for vaginal deliveries against results in abdominal delivery That index, in our clinic, is a temperature of 100 degrees

Fahrenheit occurring twice in any 24 hour period except the immediate 20 hours postpartum, the temperature being read every 4 hours

In considering Table VI, therefore the application of the above rule showed 54 of the 73 cases to be febrile 41 of them having a temperature reaching to 100 degrees at least twice on one or more days after the third postoperative day Of these 41, 18 were distributed among 25 cervical sections and 22 among 44 corporeal sections an advantage in favor of the latter operation in the group as a whole On the other hand the fever in the corporeal cases was more often referable to some pelvic or uterine lesion and the average stay in hospital was somewhat more prolonged beyond the routine 16 days laid down for uncomplicated cases With but one exception—a fatal case of peritonitis lasting 4 days—the pelvic lesions were of a minor character, none extending to the adnexa or progressing to suppuration, no positive blood cultures being returned and the longest period of postoperative hospitalization from any cause not exceeding 34 days A strict account of wound healing on the rather rigid schema proposed by the Woman's Hospital in

than the alleged greater safety and smoother convalescence of the cervical section. For the practiced obstetric surgeon there is the theoretical advantage that the scar of the cervical section, situated as it is in a quiet sector, is less apt to rupture in subsequent pregnancy and labor. We are not prepared to concede the point as proved at the present time in spite of reported figures favorable to the new operation, since we can find no figures on the incidence of rupture of fundal scars as low in the anterior wall as ours are. On the other hand, for the surgeon faced with the problem of only occasionally performing cesarean section often under unfavorable circumstances, a

consideration of some of the fundamental principles here mentioned for the improvement in execution of the simple corporeal operation may offer a safer course than recourse to a more technically formidable procedure.

Our series is admittedly too small to give these thoughts the force of conclusions. We are still engaged in a study of the subject and offer our preliminary experience as a discordant note in a chorus of praise for the cervical section which perhaps has as many potentialities for harm as for good. It is our hope that students of maternal mortality may be led to re-examine their own further experience in the light of these considerations.

## EXTRA ARTICULAR FIXATION OF SACRO ILIAC JOINT

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IN 1926 Verrall published the description of a method of fixation of the sacro iliac joint by means of an extra articular bone graft. This method consists essentially of preparing an autogenous graft taken from the crest of the tibia and inserting it through the bases of the posterior superior iliac spines and in contact with the posterior surface of the sacrum by removal of the spine of the second sacral segment. This graft, after becoming fused at the three points of contact mentioned, should persist with adequate structural integrity in accordance with Wolff's Law (2) to withstand the strains of traction and torsion incident to any motion in the sacro iliac joints. A comparatively simple and satisfactory method of dealing with intractable cases of disability due to sacro-iliac arthropathy should require no lengthy description of its utility and indications in view of the mass of literature dealing with the subject.

The technique of the operation as originally described except for one minor modification has been used in our clinic. The exposure is through a curvilinear incision, with convexity upward which connects two points located approximately 3 centimeters below and lateral to the posterior superior iliac spines. The flap is turned down thus exposing these processes and the erector spinae masses between. Longitudinal incisions are made through the periosteum over the iliac spines and the first and second sacral spinous processes and these structures are then cleared

with a periosteal elevator. The erector spinae masses are next freed sufficiently below to permit the passage of the graft. The bases of the iliac processes and the intervening sacral spine are then drilled transversally. The drilling of the base of the sacral spine, instead of its removal, constitutes the minor modification of the original technique. The use of a drill of sufficient length to connect both iliac processes has been found to facilitate the preparation of the tunnel for the graft. The point of the drill may be directed with the finger after it penetrates the base of the first iliac process so that it will not injure the erector spinae masses and also so that it will proceed directly through the base of the interspersed sacral spine to the opposite iliac process. The excavation in the iliac processes may be enlarged if necessary with a gouge or osteotome, but little difficulty will be experienced in seating the graft due to the cancellous character of the bone if the three openings are properly aligned.

A graft taken from the tibial crest of approximately 12 millimeter width and length determined by measurement is now inserted at the base of one iliac process and tapped into place with a mallet. The medullary side of the graft is placed downward to facilitate fusion over the sacrum. The drive fit of the graft maintains its position without other fixation. The wound is then closed in the customary manner. A bed is prepared with a fracture board or Bradford frame and the patient placed in a prone position

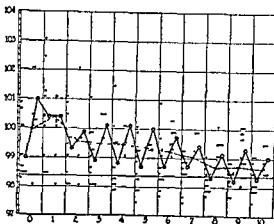


Chart 3 Extreme diurnal variations and average daily temperature after operation in 14 emergency (dystocia) cervical sections

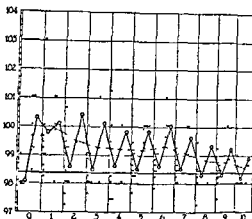


Chart 4 Extreme diurnal variations and average daily temperature after operation in 11 elective cervical sections.

series In the dystocia group however, the cervical records, while not differing much from the cervical type of convalescence in elective operations, are superior to the corporeal records in this type of case. In all the charts a considerable immediate postoperative reaction is apparent, partly as a consequence of the use of general anaesthesia, long operative time, and the burying of much catgut.

#### FOLLOW UP DATA

While 59 of the 70 surviving cases have been examined at intervals of from 6 weeks to 28 months after operation, there is no late morbidity attaching to caesarean section in general or as between the types of caesarean section, which is not characteristic of the average gynecologic section, except in the matter of subsequent pregnancy. There were no defects as to wound and no disabilities due to pelvic infection, bladder distortion, varicosities, and similar conditions. There were several temporary irregularities of menstruation, noted only in cases in which this function was re-established shortly after operation (failure to nurse the infant). These could usually be traced to a distortion of the uterine body by suspending adhesions, and in any event, no cases have remained permanently disordered or altered. With respect to future childbearing the series is admittedly too recent to yield anything of value. Five of the cases in the series have been delivered twice in the period under consideration, 3 by a second caesarean section included in the total of 73. One other has since delivered spontaneously, and the remaining case has had a caesarean section in another hospital.

#### SUMMARY

A comparative analysis of our results in cervical, as contrasted to corporeal caesarean section would appear to justify the following comments.

When the conservative operation is performed through a low uterine incision, the same being carefully sutured there will be found to be little difference in immediate convalescence as contrasted with that of the cervical section, if both are done as elective operations before labor. After the onset of labor, there will be some advantage as to safety, febrile morbidity and other factors of convalescence in favor of the cervical section. The advantage in our hands up to this time has been so slight, however, that, while hesitating to recommend a stand which would be at odds with newly reported experience in other quarters, we believe that there is yet hope for increased safety in the relatively simple corporeal operation after the onset of labor. While no assurance of safety in section removes the necessity for good obstetric judgment in the conduct of cases of questionable disproportion, surgeons who now resort to elective section in preference to the risks of operation late in labor or because of the difficulties of the cervical section may, by following the suggestions outlined find it possible safely to employ test labors more frequently. By so doing they may find, as we have found a further gratification in a diminished necessity for resort to section generally.

As for the thesis now advocated that the cervical section should replace the corporeal operation as a routine method in all cases requiring operation, our results would suggest that the decision might conceivably be made upon other grounds.

than the alleged greater safety and smoother convalescence of the cervical section. For the practiced obstetric surgeon there is the theoretical advantage that the scar of the cervical section, situated as it is in a quiet sector, is less apt to rupture in subsequent pregnancy and labor. We are not prepared to concede the point as proved at the present time in spite of reported figures favorable to the new operation, since we can find no figures on the incidence of rupture of fundal scars as low in the anterior wall as ours are. On the other hand, for the surgeon faced with the problem of only occasionally performing cesarean section, often under unfavorable circumstances, a

consideration of some of the fundamental principles here mentioned for the improvement in execution of the simple corporeal operation may offer a safer course than recourse to a more technically formidable procedure.

Our series is admittedly too small to give these thoughts the force of conclusions. We are still engaged in a study of the subject and offer our preliminary experience as a discordant note in a chorus of praise for the cervical section which perhaps has as many potentialities for harm as for good. It is our hope that students of maternal mortality may be led to re-examine their own further experience in the light of these considerations.

## EXTRA-ARTICULAR FIXATION OF SACRO-ILIAC JOINT

WINTHROP M. PHELPS, M.D. AND MERRILL K. LINDSAY, M.D., F.A.C.S., NEW HAVEN, CONNECTICUT  
From the Department of Surgery, School of Medicine, Yale University

IN 1926 Verrall published the description of a method of fixation of the sacro iliac joint by means of an extra articular bone graft. This method consists essentially of preparing an autogenous graft taken from the crest of the tibia and inserting it through the bases of the posterior superior iliac spines and in contact with the posterior surface of the sacrum by removal of the spine of the second sacral segment. This graft, after becoming fused at the three points of contact mentioned, should persist with adequate structural integrity in accordance with Wolff's Law (2) to withstand the strains of traction and torsion incident to any motion in the sacro iliac joints. A comparatively simple and satisfactory method of dealing with intractable cases of disability due to sacro iliac arthropathy should require no lengthy description of its utility and indications in view of the mass of literature dealing with the subject.

The technique of the operation as originally described except for one minor modification has been used in our clinic. The exposure is through a curvilinear incision, with convexity upward, which connects two points located approximately 3 centimeters below and lateral to the posterior superior iliac spines. The flap is turned down thus exposing these processes and the erector spinæ masses between. Longitudinal incisions are made through the periosteum over the iliac spines and the first and second sacral spinous processes and these structures are then cleared

with a periosteal elevator. The erector spinæ masses are next freed sufficiently below to permit the passage of the graft. The bases of the iliac processes and the intervening sacral spine are then drilled transversally. The drilling of the base of the sacral spine, instead of its removal, constitutes the minor modification of the original technique. The use of a drill of sufficient length to connect both iliac processes has been found to facilitate the preparation of the tunnel for the graft. The point of the drill may be directed with the finger after it penetrates the base of the first iliac process so that it will not injure the erector spinæ masses and also so that it will proceed directly through the base of the interposed sacral spine to the opposite iliac process. The excavation in the iliac processes may be enlarged if necessary with a gouge or osteotome, but little difficulty will be experienced in seating the graft due to the cancellous character of the bone, if the three openings are properly aligned.

A graft taken from the tibial crest of approximately 12 millimeter width and length determined by measurement is now inserted at the base of one iliac process and tapped into place with a mallet. The medullary side of the graft is placed downward to facilitate fusion over the sacrum. The drive fit of the graft maintains its position without other fixation. The wound is then closed in the customary manner. A bed is prepared with a fracture board or Bradford frame and the patient placed in a prone position



Fig 1 Exposure and method of inserting graft



Fig 2 Graft in place



Fig 3 Case 1 Patient's habitual posture before operation



Fig 4 Case 1 Photographs on discharge



Fig 5 Case 1 Radiograph of pelvis showing graft one month after operation



Fig 6 Case 1 Radiograph showing graft one year after operation



Fig 7 Case 2 Radiogram showing graft 3 months after operation



Fig 8 Case 3 Radiogram showing graft 6 weeks after operation

which is continued until the sutures are removed. The period of recumbency depends on the character of the case in point. In any case not involving a destructive process in the sacro iliac joint active flexion and extension of the knees and hips may be started in bed after 3 weeks and gradually increased provided there is no associated discomfort. When the motion in hip joints has become comparatively free and painless, the patient may be allowed to get up.

The preceding method was used in our clinic in three consecutive cases of intractable sacro iliac pain in which there was no radiographic evidence of gross pathology. These patients all returned to their customary manual labor within four months and reported symptom free after one year.

One of the accompanying illustrations shows the graft in position one year after operation.

#### ADVANTAGES

As pointed out in the original paper the extra-articular graft or tie beam method of fixing the sacro iliac joint has several advantages.

- 1 It is a correct sacro iliac support from a mechanical standpoint.
- 2 The procedure is comparatively simple.
- 3 In tuberculosis it does not involve opening the joint.

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## SINGLE INGUINOSCROTAL INCISION FOR DOUBLE HYDROCELE OPERATION

OR HYDROCELE ON ONE SIDE AND INGUINAL HERNIA ON THE OTHER

COMMANDER JOSFIIH J A McMULLEN MC, USN, MD FACS ST CROIX VIRGIN ISLANDS U S A

**I**N performing the radical operation for hydrocele, some surgeons prefer an incision extending over the lower inguinal and upper scrotal regions. The skin, dartos, intercolumnar, cremasteric, and infundibuliform fasciæ are incised down to the parietal layer of the tunica vaginalis. The hydrocele is delivered into the incision by means of external pressure on the scrotum. When necessary, the sac is freed from the scrotal coverings by means of a gauze sponge or by blunt or sharp dissection. I have used a unilateral inguinoscrotal incision in operations upon eight bilateral hydroceles and upon three patients who had a hydrocele on one side and an inguinal hernia on the other. If the hernia and hydrocele are on opposite sides, a full length herniorrhaphy incision is made on the side of the hernia. The incision is

extended downward on the anterior surface of the scrotum as far as may be necessary to deliver the hydrocele on the other side. The hernia is repaired first. The hydrocele on the side opposite the hernia is delivered as follows: the scrotal septum is incised and the tunica vaginalis is freed from the scrotal attachments. As a routine measure I prefer to drain by making a small counter incision through the lower scrotal wall. I omitted drainage in some cases and the results were good.

It is a sound surgical principle that any given operation should be accomplished with a minimum amount of operating. The plan to remove a bilateral hydrocele through one incision eliminates the making and repair of the customary double incision, and thereby saves time and minimizes the amount of operating.

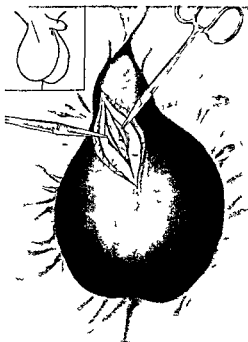


Fig 1 Showing line of incision for operation on bilateral hydrocele

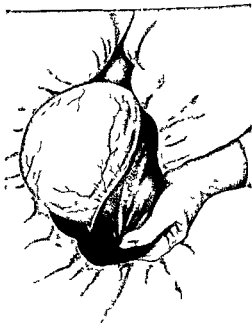


Fig 2 The right side has been repaired by the usual Jaboulay technique and the left hydrocele is being delivered through the original incision by external pressure

Briefly the technique of single incision for the radical cure of bilateral hydrocele may be described as follows

1 An incision is made over the lower inguinal and upper anterior scrotal regions

2 The hydrocele on the side of the incision is delivered and the conventional sac everting operation is performed (In large hydroceles part of the sac is resected)

3 The hydrocele on the opposite side is pushed toward the incision, the scrotal septum is incised, and the hydrocele delivered through the opposite inguinoscrotal wound where again the usual "bottle" operation is performed

4 The testicles are placed in their proper scrotal compartments, the septum is repaired, and the wound is closed with or without drainage Absolute hæmostasis is essential



TREATMENT OF CONGENITAL DISLOCATION OF THE HIP BY A NEW METHOD<sup>1</sup>HENRY O. FEISS, A.B., M.D., D.Sc. (Edin.) CLEVELAND, OHIO  
Division of Orthopedic Surgery, Fairview Park Hospital

THE author made a report on the treatment of congenital dislocation of the hip in this journal<sup>2</sup> almost 20 years ago. At that time he described a method by which he attempted to eliminate the use of plaster of Paris, this being probably the first attempt in the history of the subject to do away with that medium. Instead of plaster of Paris, he used a framework made of metal bands one inch or so wide, enclosing the pelvis and thigh, with a connecting band running down the side. The bands were very carefully padded and like a plaster encasement the whole thing was given the shape and position required by the angle made by the thigh with the trunk after reduction. This mechanism was of course, prepared and fitted as far as possible, beforehand, so as to be ready to apply immediately after the reduction of the hip.

The author believed that there were distinct advantages in this method of treatment, viz., the speed and neatness of application of the apparatus, the possibility of its accurate adjustment, and the great gain in cleanliness of the enclosed parts owing to improved ventilation. Nevertheless, as it happened, this method had to be dropped, first because of the quick onset of sloughs from the pressure of the bands in spite of the thick padding which pressure could not be controlled and secondly because of the failure of the mechanism to hold the joint reduced. Then for the time being the author returned to the use of plaster of Paris.

However in recent years after his return from overseas, the subject was again taken up but in a different and much more serious vein because it had now come home to him and this point was entirely missed originally, that there was an advantage brought out by the non plaster treatment which could never be hoped for by the plaster method. This point was of such tremendous importance that he could not escape the responsibility of reconsidering the subject and attempting to develop a new technique which would overcome the difficulties encountered in his earlier experience. The point of great advantage referred to, is that with the old method of using plaster treatment has to be postponed until the child is old enough to control urination,

else the plaster encasement becomes soaked with urine and is ruined. This usually means that the child has to be 3 or 4 years old before beginning treatment. With the non plaster treatment if a retaining apparatus could be developed which is not damaged by urine, treatment might be instituted immediately on recognition of the condition no matter how young the child which usually means as young as 14 to 16 months. Naturally then reduction is a comparatively simple affair, whereas at the age of 3 or 4 years it is not.

With these facts in mind the author finally succeeded in developing such an apparatus which he believes, eliminates the shortcomings of the earlier ones, and the object of this report is to describe his present procedure.

## THE RETAINING APPARATUS AS NOW USED

The retaining apparatus is made to include both limbs in every case, even if only one is involved. There is first of all, one large abdominal cuff at least 5 inches broad which incloses the lower part of the trunk, extending down in front as far as the bent thighs permit, and carried far down behind over the back of the buttocks so as to support the tuberosities of the ischia and the hip joints. For obvious reasons this is shaped so as not to cover the cleft between the buttocks. There are also cuffs for each thigh and upper leg about 4 and 2 inches broad respectively. All 5 cuffs are made of aluminum which is faced on the skin side with felt at least one inch thick, the whole being enclosed in the usual brace covering. The cuffs are fastened to the enclosed parts with straps and buckles.

The other feature consists of two connecting iron posts one on each side which holds the cuffs in the desired relationship. These are of 1/4 inch square stock untempered and pass through boxes fastened to the cuffs thus permitting readjustment in position. They are held fastened to the boxes by screws. These posts must be placed somewhat posteriorly so that they may be bent into shape without encroaching into the angles between the cuffs. There are two bends in each post each forming approximately a right angle one at the hip and the other at the knee.

In fitting the cuffs are first applied to the parts and then the connecting posts shaped adjusted,

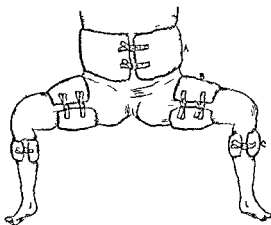


Fig 1 Anterior view A B and C Pelvic thigh and leg cuffs respectively

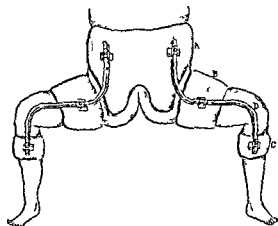


Fig 2 Posterior view A B and C as in Figure 1 D Iron post connecting cuffs This is of  $\frac{1}{4}$  inch stock untempered and slides through boxes attached to the cuffs A screw tightens it in each box

and fastened where required. As in the earlier work the apparatus should be ready to apply immediately after the reduction of the hip.

The fittings, both preliminary to and after reduction, should be as accurate as possible, not only for the sake of maintenance of the position of the thigh, but also to distribute pressure as uniformly as possible so as to prevent sloughs.

In using this contrivance there are three details of special importance which should be emphasized: (1) the thickness of the padding; (2) the posterior extension of the pelvic cuff down over the buttocks, and (3) the fact that the iron posts are placed well posteriorly.

#### REDUCTION (FOR CHILDREN ONE TO TWO YEARS OLD)

The retaining apparatus having been prepared and fitted, one may go ahead with the reduction and in doing so may use any method he desires or to which he is accustomed. But it should be emphasized that in dealing with a child a little over a year old, one is dealing with very delicate structures and the greatest care should be used to avoid breaking the bone or stretching the artery or nerve unduly. For this reason the author offers his own technique as it permits the handling of the parts with comparatively little traumatization.

The method is briefly as follows. After the patient is anesthetized the thigh and knee are flexed the limb being grasped at the ankle, and then with a circular, prying motion, a preliminary attempt is made to place the head over the socket, the approach being made from behind. This is repeated and if the adductors are very tight they

should be stretched or tenotomized so that they offer no resistance. After the manipulation is carried out a few times one obtains a slight click at the joint which is felt more than heard. Once obtained, the exact manipulation which brings about the click is repeated until the click becomes plainer. This should be repeated again and again until eventually a distinct sharp movement of the head takes place instead of the click, this being the entrance of the head into the socket. The manipulations are repeated until stability is reached so that the head stays in its new place even when moderately large movements of the thigh are made to test it. After stability is gained and maintained it is probably noted that the thigh is practically at a right angle to the central longitudinal line of the body. Then apply and carefully refit the prepared apparatus and take roentgenograms with the patient still under the anesthetic. If a reduction is shown that is all there is to do, the apparatus simply being left on. If the hip is not reduced according to the roentgenogram, one may repeat the manipulation perhaps several times until the result desired is achieved.

In all the proceedings as already noted, no great force is used and the time required for the reduction should not be over 15 minutes. The adductors having been stretched and tenotomized, they will offer no resistance but to be sure of their complete stretching it may be wise to elongate them further by sinking their tendons near their origin with sharp but not too forceful blows with the outside of the hand.

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<sup>1</sup>Surg. Gynec. & Obst. 1910 21 302

With the assist. of Mr. Geo. Guilford in the Mechanic I. Feiss res.

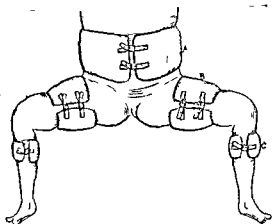


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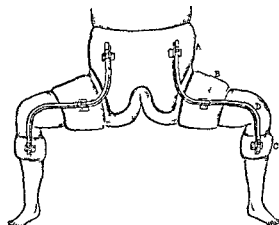


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In all the proceedings as already noted, no great force is used and the time required for the reduction should not be over 15 minutes. The adductors having been stretched and tenotomized they will offer no resistance but to be sure of their complete stretching it may be wise to elongate them further by striking their tendons near their origin with sharp but not too forceful blows with the outside of the hand.

If, in spite of careful technique, roentgen pictures show no or incomplete reduction, one should be satisfied for the time being. Occasionally, if the apparatus is simply left in place, the head will spontaneously slip in itself after a time, or it will improve its position. Even if this does not occur, the chances are that in anesthetizing again, say 2 weeks later, a complete reduction will be obtained with ease.

It may be well to repeat that whether one or both hips are dislocated, both hips should be included in the retaining apparatus in every case, not only for the sake of stability but also so as to be able to compare the two sides. After reduction the child is put to bed.

#### STAGE OF CONVALESCENCE AFTER REDUCTION

In this stage of treatment, the aim is simply to get the child back on its feet and consists in leaving off the apparatus while the child is still in bed, for increasing periods of time each day, beginning about the fourth or fifth month after reduction.

In some cases it might perhaps be wise to bring down the thighs gradually while the apparatus is still being worn, which is accomplished by straightening the iron posts at the hip angles a little more every few days. The author, himself, does not use this measure, preferring to loosen the patient's joints after the apparatus has been taken off for good. But in no case should the child be placed on its feet while still wearing the machine. Passive motion applied by mother or attendant each day should soon obliterate the stiffness, and if necessary one may resort to a manipulation under ether. In this stage frequent measurements should be made and an occasional roentgenogram should be taken to control other observations.

#### PROGNOSIS

This report is presented as carrying with it only the importance of its face value. The number of cases on which it is based is not large but the last 5 cases treated have resulted in complete cures and 4 of these were only a little over a year old when treatment was started. It is true that it might have been better to have waited until a larger series of cases could have been thus treated. However, this would have meant a delay of several years before a report could have been published, and it seemed wiser to the writer to give others the benefit of his experience and good results thus far even though the number of patients treated is small.

In passing it may be well to state that it has not seemed necessary in this paper to describe individual cases as one case is hardly distinguishable from another and a hip reduced very quickly takes the characteristics of a normal hip. Photographs of patients have also been omitted for in the last analysis credibility is a personal matter of statement and requires no circumstantial evidence to be convincing.

The method of treatment here described is the result of many years of study, the writer's first acquaintance of the subject dating back from his out patient days at the Boston Children's Hospital almost 30 years ago and includes experience in many foreign clinics. As this method evolved itself step by step and finally crystallized into its present concrete shape, the age for beginning treatment became lower and lower and the prognosis better and better. The writer believes that the majority of patients, perhaps all patients if treated early enough, will be completely cured and finally that this cure can be brought about in less than one half the time required by the older methods.

# EDITORIALS

## SURGERY, GYNECOLOGY AND OBSTETRICS

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Chief of Editorial Staff

OCTOBER 1929

### THE CLINICAL DIAGNOSIS OF INTRA-ABDOMINAL MALIGNANT DISEASE

SEVERAL benign intra abdominal lesions simulate malignant disease so closely that differentiation before operation is difficult. A large ovarian fibroma in a young adult is frequently accompanied by ascites a combination which may lead to a hasty and erroneous diagnosis of malignancy.

Recently, in the case of a middle aged woman, a protuberant abdomen distended with fluid and an indistinctly palpable in durated pelvic mass made a clinical diagnosis of papillary carcinoma of the ovary with ascites almost a certainty, yet the fluid was found to be encapsulated in a huge benign ovarian cyst entirely filling the abdomen. The irregular pelvic mass was due to small uterine fibromyomata which had been im packed in the pelvis by the pressure and the weight of the ovarian cyst.

In a case in which exploration was performed for a bleeding lesion of the right kidney the abdominal distention was found to be caused by a huge hydronephrotic sac. The

bleeding originated in a papillary carcinoma of the renal pelvis. Although prior to operation the unilateral renal bleeding and the abdomen distended with fluid seemed to point to extensive malignant disease, the lesion was found at operation to be localized and operable.

A stony mass was palpated in the region of the prostate gland in the case of a patient who had complained of urinary dysfunction for a comparatively short time. Carcinoma of the prostate gland was strongly suspected. Roentgen ray examination of the urinary tract showed that the indurated mass was a huge urinary concretion, pyramidal in shape occupying the exact position of the prostate gland, removal of this stone relieved the urinary obstruction.

A diseased gall bladder in an elderly patient sometimes interferes with the neuromuscular control of a segment of stomach to such an extent as to lead to the erroneous pre operative diagnosis of gastric tumor. If the symptoms are pronounced and the involvement extensive surgical removal might be despaired of. Yet at operation it may be discovered that the disturbance of motility centers around a diseased gall bladder in an otherwise normal gastro intestinal tract.

Such are examples of the similarity between the pre-operative clinical manifestation of benign and malignant intra abdominal lesions. They illustrate how guarded should be the pre-operative clinical diagnosis of malignant disease in the abdomen and how unwise it is to despair of the prognosis before the exact nature and extent of the lesion is revealed.

WALTMAN WALTERS

## LIVER REGENERATION

THE idea of liver regeneration comes down from antiquity. Upon it is founded the myth of Prometheus whose punishment for bringing fire to man was that a vulture sent by Jove should each day feed upon his liver. Hildanus, in the second century, was the first to mention the repair and healing of liver wounds. Cruveilhier suggested the possibility of liver regeneration in 1830.

Clinical and experimental evidence have both pointed the way. Pathological lesions of the liver, such as subacute yellow atrophy with its subsequent "nodular adenomatous hypertrophy," have demonstrated this inherent ability to restore itself.

This capacity for regeneration has been shown experimentally by damaging the liver with toxic substances such as chloroform or phosphorus, or by removing large portions surgically. This latter method is simple, graphic, and convincing. The single objection to it is that restoration of liver tissue does not occur at the pedicle from which it was removed and so does not fall within the biological definition of "regeneration" which demands that regeneration take place at the site of removal. The restoration is confined to the remaining lobes which hypertrophy that they may contain the regenerated lobules, newly formed to replace those in the excised portion.

Sixty-five to seventy-five per cent of the dog's liver is easily excised. Within two short weeks, this remnant closely approximates the original weight and volume. Six more weeks must elapse before the normal liver histology is restored.

The chief cellular activity is at the periphery of the lobules. Here mitotic figures may be found 2 days after partial liver removal. The

hepatic cells are the chief source of new liver tissue but the bile ducts play a definite rôle by sending forth buds of proliferating cells. The transition from these proliferating duct cells to new hepatic cells is extremely gradual. The process closely resembles the embryonic development of the liver. The stress of regeneration seems to have caused a reversion to the primitive mode of production of hepatic cells in which the undifferentiated biliary capillaries give rise to new hepatic cells by dichotomous branching.

Eight weeks after partial hepatectomy, the newly formed hepatic tissue cannot be distinguished from normal liver. The old lobules do not hypertrophy but undergo a hyperplastic budding process at their periphery, productive of new lobules so similar in size and shape as to be indistinguishable from the old. Here again the analogy to the embryological development of the liver is evident.

Of greater interest is the apparently infinite capacity of the liver to restore itself. Even after a second or third partial liver removal the remaining portion restores itself to an approximation of normal. As before the regeneration is confined to the remaining lobes which undergo a tremendous hypertrophy, but the resulting tissue is normal hepatic parenchyma. After repeated partial hepatectomy the restoration is as complete and rapid as after the first. Only technical difficulties with hæmostasis prevent further removal.

At this stage more hepatic tissue will have been removed than the animal possessed before the experiment began. And yet, when the animal is killed it will be found to possess as much liver tissue as one would expect to find in a normal dog of similar weight.

These animals never present a picture of hepatic insufficiency. Bile is always present in the duodenum. They thrive on a routine

mixed diet, which includes meat. The various liver function tests have shown their hepatic function to be normal at all times.

Regeneration seems to depend upon an unhampered portal circulation. For example, after making an Eck fistula which shunts the portal blood directly into the inferior vena cava, there is no restoration after partial hepatectomy. Nor does regeneration occur after the production of experimental cirrhotoses of sufficient intensity to occlude the portal intake, either by ligating the common duct or by prolonged feeding of carbon tetrachloride.

These procedures certainly do not lessen or destroy the need of the organism for functioning hepatic tissue. It seems likely that some other factor than functional lack is involved since restoration takes place only in the presence of an intact portal blood supply.

The liver, then, in the absence of lesions which obstruct the portal blood supply either directly or indirectly, shows an infinite ability to restore itself after repeated trauma. No other organ remotely approaches the liver in its capacity for regeneration.

F C FISHBACK



## LIVER REGENERATION

THE idea of liver regeneration comes down from antiquity. Upon it is founded the myth of Prometheus whose punishment for bringing fire to man was that a vulture sent by Jove should each day feed upon his liver. Hildanus, in the second century, was the first to mention the repair and healing of liver wounds. Cruveilhier suggested the possibility of liver regeneration in 1830.

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F C FISHBACK

# MASTER SURGEONS OF AMERICA

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## FREDERICK WILLIAM PARHAM

**I**N the death of Frederick William Parham, on May 7, 1927, the medical profession lost one of its ablest and most beloved surgeons. He was born in New Orleans on March 20, 1856, the son of John Greenway and Mary Blount Parham. His early education was received in the public schools of his native city and his collegiate work done at Randolph Macon College of Virginia. He studied medicine at the University of Louisiana, now Tulane University, and later did post graduate work in Philadelphia.

Essentially a scholar, a student not only of medicine, to which he devoted his life, but a lover as well of art and music. He had a keen analytical mind and sound medical judgment. It was his great devotion to surgery and his untiring efforts to improve this branch of medicine which inspired his associates to greater deeds, and it was their co-operation which had much to do with firmly establishing aseptic surgery in the wards of the Charity Hospital of New Orleans.

The history of his life's work would be incomplete without a short sketch of his accomplishments in this great institution, for it was here he spent his spare moments and gave freely of his time, not only for the advancement of surgery, but to the establishment of new regulations in the management of the hospital tending toward the improvement of standards and the betterment of the staff.

It is astonishing that a man of such frail physique could accomplish some of the herculean tasks he undertook, for in those days reforms were slow to introduce and accepted only after convincing proof. From the time he entered the hospital as an interne in 1877, a position he won in competitive examination until his death fifty years later, his interest never ceased.

It was through his direction, while assistant house surgeon 1883-1887, that a system of antiseptic methods was established in the obstetrical wards, which practically eliminated the scourge of puerperal infection from this department.

In 1889, immediately after his return from the European clinics where he studied under such masters as Czerny, Bramann, Hohen and Ewald and where he gained a thorough knowledge of the teachings of Lister and Pasteur, Dr. Parham established in his wards at the Charity Hospital, at his own expense, a sterilizing outfit and faithfully carried out the directions for the sterilization of hands, dressings, instruments and ligatures as well as the preparation of pa-



FREDERICK W. PARHAM  
1856-1927



tients For this achievement he soon had the satisfaction of seeing the gospel of asepsis spread through other wards, especially by those of his disciples who were converts and who later equipped for this work, through their own efforts, services to which they were assigned The relation of such an incident may seem strange in this era, but it was not an easy matter at that time to convince the older heads of the profession that their ideals were false The proof, however, was so convincing that they too soon joined the ranks of the progressives

Dr Parham's wards were a veritable laboratory of research, and one experiment after another was tried until a satisfactory solution could be reached

In those days the hospital was filled with chronic ulcers of every description Relief must be given these poor sufferers, and for a long period of time leg ulcers became the absorbing question Every form of graft was tested until it was fully demonstrated that autografts alone could be depended upon

The mortality in compound fractures ranged as high as 70 per cent prior to the application of aseptic treatment to wounds, but once established, men who only a short while before were compelled to sacrifice a leg to save their lives, walked out of the institution with useful limbs It was in this work that his interest in the treatment of fractures was first stimulated, and though devoid of any mechanical skill, he called to his assistance those who could supply this defect After years of labor, and largely through his efforts, this branch of surgery progressed to the dignity of a specialty, and today fractures in the hospital are segregated and treated by his pupils who have thought it worth while to devote much of their time to this branch of surgery

It was in the Charity Hospital that Dr Parham did his first thoracotomy for tumor of the thoracic wall, which later made his name international

Perhaps the greatest piece of constructive work done for the institution was the reorganization of its staff, and to none is more credit due than to this one man This work stands today as another monument to his untiring energy and great desire to put the hospital on the same basis as other institutions of its kind in America

In recognition of his services a life size portrait, the gift of the staff, hangs in the library of the Charity Hospital with the following inscription "Frederick William Parham—1856—1927—Surgeon, Teacher, Administrator, Friend"

Dr Parham devoted much time to sanitation, and under his direction while sanitary inspector in the nineties, the first clinical laboratory was installed in the City Board of Health, where under his supervision cultures were made, and with the co operation of the profession the mortality in diphtheria alone was reduced from 35 to 8 per cent

Like a great general, Dr Parham thought not of his own glorification, nor the financial benefits to be gained, but always of the great good that others might derive from his efforts Whatever he found of benefit to mankind he gave

eagerly to the profession. One has only to read his publications to appreciate the character of the author. Although modest and retiring in the extreme, at times even diffident, he wielded an influence among his fellow men which few have ever enjoyed, he was quick to extol virtue and merit, but even quicker to condemn quackery and unethical practices. These characteristics were particularly noticeable during the more recent epidemics of yellow fever. Once the disease had been recognized he opposed concealment, believing that truth was always the better policy. In all matters of health or sanitation his advice was sought, and none was more active than he in fighting for the suppression of a disease so injurious to the good name of New Orleans. No matter what members of the profession thought of him personally, they knew that his opinion in any controversy was based upon facts and given only after convincing proof.

Dr. Parham was recognized by his fellow practitioners not only for his skill as a surgeon, but likewise for his ability as a diagnostician. Well equipped with a knowledge of the principals of surgery and with years of experience, he was always a reliable consultant. Nor could he be persuaded to operate on any patient unless he was reasonably certain of giving relief to the sufferer.

Though honored by every association to which he belonged, these honors came unsought. He was president of the Southern Surgical Association, vice president of the American Surgical Association, president of the Louisiana State Medical Society and the Orleans Parish Medical Society. He was also a fellow of the International Society of Surgery, he was a founder of the American College of Surgeons and served for many years as a regent of this association. At the time of his death he was consulting surgeon of the staff of Touro Infirmary and Charity Hospital. He was one of the organizers of the Graduate School of Medicine of Tulane University and professor of general and abdominal surgery in this institution from 1896 to 1914, and from 1925 until his death.

For many years he was chairman of the Medical Advisory Committee of the Board of Administrators of Tulane, and it was during this régime that many of the reforms which marked the advance of the history of the school were introduced. It was in recognition of his outstanding work as a surgeon and his self sacrificing efforts in the interest of medicine that Tulane University conferred upon him the degree of doctor of laws, in June, 1925.

Among his most valuable contributions to the profession are "Resection of the Thoracic Wall for Tumor", "Vesico Intestinal Fistula", "Inaccessible Vesico Vaginal Fistula", "Hypospadias", "Head Injuries Marked by Intracranial Tension", and numerous articles on fractures and other subjects.

His own interest was always sacrificed for the good of others. He loved his work as a means of affording relief and comfort to the poor and suffering. His good deeds alone are on record, for his ideals were the highest and noblest.

E. DENEGRÉ MARTIN







# THE SURGEON'S LIBRARY

## OLD MASTERPIECES IN SURGERY

ALFRED BROWN M D F A C S OMAHA NEBRASKA

### ARETÆUS THE CAPPADOCIAN

OF the life of this distinguished physician of the early Christian era nothing is known. Even the exact period during which he lived is uncertain and can be determined only by inference. In the Greek manuscripts of his work he is referred to always as Aretæus the Cappadocian. Consequently he was probably a product of that far eastern country lying north of Mount Taurus and west of the Euphrates which passed from being a part of the Persian kingdom to the position of a semi-independent state by favor of Antony and Octavian and finally, on the death of its ruler Archelaus was reduced to a province of the Roman Empire by the Emperor Tiberius in the first quarter of the first century of the Christian Era. We can gather from his writings that he probably lived in Rome for he prescribes the favorite Italian wines of the early Christian period and this would place him some time after his country had become Romanized for a citizen of an unfriendly nation would hardly go to Italy to remain and if he were in far off Cappadocia he would probably not prescribe Italian wines for his patients.

As to his exact period the hypothesis given by Francis Adams in *The Extant Works of Aretæus The Cappadocian* London 1861 is most interestingly worked out and probably correct. Adams states that it became the rule in the age of Quintilian for contemporary authors to ignore the existence of one another particularly if they were writing on similar subjects. Searching the works of Aretæus one finds that there is a great similarity between his work and that of Galen. Their ideas are much the same. Their opinions and knowledge of the pulse coincide. They prescribe the same simples and in some instances the same compound medicines for the same conditions. The anatomy taught by each of them agrees with that of the other. Above all each patterns after Hippocrates and shows considerable knowledge of the Platonic philosophy. So Adams says. Altogether then there is such a conformity between both their theoretical and practical views in their profession as we never find to exist except between authors who lived in or about the same period. The great difference between Aretæus and Galen is that they wrote in different Greek dialects. Aretæus using the Ionic and Galen the Attic. Whether this was only an evidence of dialectic

or literary taste Aretæus preferring the Homeric poems and Galen the Athenian drama or whether being contemporaries and surely rivals they preferred to ignore each other even so much as to write in different dialects is purely a matter of opinion. It would appear however that Aretæus was a contemporary of Galen and flourished somewhere about the latter part of the second century A D.

Judging from what we now have of the writings of these two men Galen was by far the more prolific writer but whether this is fact or only that more of Galen's work remains to us is only a guess. Aretæus did write more than has been found for he refers to a surgery that he had written of which we have no trace so we are left in the dark as to the actual amount of writing done by this prominent physician and surgeon.

Aretæus is referred to by only a few of the writers of the Byzantine period and was wholly neglected by the Arabians. He did not appear to be popular and even in the early Renaissance nearly all of the older Greek authors were translated into Latin and published before his works were taken up translated by Junius Paulus Crassus and published in Venice in 1555. Crassus says in his preface dedicated to the Illustrious Prince Albert that the manuscript (in the front of the book the name of the author was written Aretæus, called the Cappadocian) was in poor condition and fragmentary when it fell into his hands and he believed it should be translated and saved for posterity. The work was reprinted in 1554 and in 1557 this translation by Crassus is the first work printed in the *Medica Artis Principes* of Stephanus. From that time on the work of Aretæus was reprinted frequently. It was translated into English first in 1783 by Moffat again in 1837 by Reynolds and in 1856 the translation by Francis Adams was published by the Sydenham Society.

Aretæus wrote on the causes and symptoms of both acute and chronic diseases and the therapeutics of both. He describes tetanus, quinsy, ulcers of the tonsils and pleurisy. He includes empyema and abscesses of the lungs among the chronic diseases rather than the acute. He writes of vesical stone and advises perineal cystotomy but gives no detailed directions as to the method of operation. The same neglect of surgical technique is found in all this his medical work and it is extremely unfortunate that his surgical treatise, to which he refers, has been lost.

## REVIEWS OF NEW BOOKS

THIS volume on *Teeth and Jaws Roentgenologically Considered*<sup>1</sup> should be very useful to the dentist who makes his own radiographs, for the reason that it outlines the fundamentals of technique which if mastered would enable him to produce skiagraphs of a much higher grade of usefulness than those usually seen.

The author is to be commended for the statement on page 10 viz., 'Roentgen ray interpretation should never be accepted by a dentist as a diagnosis *per se* as the skiagraph should be considered as a diagnostic aid only, except in a few cases where it is conclusive. This statement applies equally to the physician. The practice of some radiographers of making unequivocal diagnoses and even advising the patient as to the character of therapeutic measures, is pernicious and should be discontinued. Such suggestions as these speak well for the value of the book.

Chapter II on normal X ray, anatomy, variations and artifacts should be mastered by every one attempting radiography.

Chapter III is equally important as the angle of incidence and the principal ray must be comprehended, and this implies a knowledge of the particular anatomical parts which are prone to conditions of disease.

The author's contention that 'Pulpless teeth showing no roentgenographic or clinical evidence of infection can, in the majority of cases, be safely retained in the mouths of patients who show no evidence of systemic disease' is absolutely right and neither physicians nor dentists should order them extracted simply because they may be a potential menace.

The latter half of the book is devoted to very excellent enlarged reproductions of pathological conditions as shown by the radiograph.

The book will be of much value to the technician, physician, and dentist. H. A. PORTS

By operative tactics the authors of *Opérations des Vésicules Biliaires*<sup>2</sup> include an exact appreciation of the patient's resistance, a precise inventory of the lesions and of their severity, a correct exploration of pathological organs including their connections and particular anatomical characteristics and finally a thorough knowledge of the different technical procedures and of the results one may obtain through their use.

Every possible phase of the subject is closely analyzed. Pre-operative investigations and care ana-

esthetics and the various incisions employed all are gone into very carefully. The illustrations are not always anatomically correct though artistically reproduced, this is particularly true of the classical incisions. One is somewhat surprised to find that the gall bladder is still sutured to the parietal peritoneum in cholecystostomy, a useless and obsolete technique. There is an excellent description of biliary catheterization, duodenotomy, and retrograde catheterization. The last two chapters are devoted to a consideration of postoperative complications and postoperative care.

The book can be highly recommended to the general surgeon with a reading knowledge of French medical terminology. GEORGE DE TARNOVSKY

INTEREST in spinal anesthesia, in spite of resistance or indifference on the part of many surgeons is steadily growing. In reading the excellent monograph on this subject by Charles H. Evans<sup>3</sup> one can but feel that with exact indications, proper drugs, watchful care and ever ready emergency measures spinal anesthesia is a wonderful achievement. The subject of the physiology of symptoms accompanying spinal anesthesia has never been so comprehensively and lucidly summarized as in this monograph. The importance of understanding the perversions of function during and after spinal anesthesia is well pointed out. In consequence, the care of the patient becomes fundamentally sound. The contra-indications are enumerated in great detail.

The author describes a method carefully worked out based on the use of neocaine dissolved in spinal fluid. Adrenalin given intramuscularly maintains the blood pressure. While the use of spilocain advocated by Pitkin is described its general use is not recommended. That is a noteworthy attitude as most surgeons who have had experience with crystalline neocaine in spinal fluid have remarked on the benefit of Pitkin's methods. The reviewer would have welcomed more evidence that the Pitkin method is not suitable for the 'beginner or the busy surgeon.'

This monograph appears at a most welcome time. Everybody is flying and daily wrecks are reported in the newspapers. Everybody is beginning to be interested in spinal anesthesia and is using it for minor surgery, with poor or misunderstood indications. Dr. Evans warns of the dangers, emphasizes the complications, and is a safe pilot in the new spinal wave. His book deserves wide distribution. LÉNA DE TAKATS

THE spine as we all know is a very difficult part of the osseous system to examine even with the X ray. Drs. George and Leonard have done much

<sup>1</sup> ANNALS OF ROENTGENOLOGY. A SERIES OF MONOGRAPHIC ATLASES. Edited by JAMES T. CASE, M.D. Vol. V.—Teeth and Jaws Roentgenologically Considered. Edited by H. H. HANSEN, M.D. 2d ed. rev. New York: Paul B. Hoeber Inc., 1930.

<sup>2</sup> LA TECHNIQUE OPÉRATOIRE. Published under the direction of M. POULBEAU and W. M. STERN. Technique Opératoire des Vésicules Biliaires. By W. M. STERN and R. FOURCIE. Paris: GASTON DOIN, 1930.

<sup>3</sup> SPINAL ANESTHESIA (SPINAL ANESTHESIA). RADIOLÓGICAL MONOGRAPH. BLOCKS. PRINCIPLES & TECHNIQUE. Charles H. EVANS, M.D. Introduction by W. W. YOUNG, M.D., F.A.C.S. Foreword by Charles Gordon H. YOUNG, M.D., F.A.C.S. New York: Paul B. Hoeber Inc., 1931.

in their book<sup>1</sup> to make the spine at least more comprehensible. Based on an abundance of experience covering many years of careful work they have added a book much needed by all roentgenologists and orthopedists. Unlike many text books this book describes in detail many of the less common diseases that usually are only mentioned in other works of this kind. In this respect the book is of great value as a reference. The subject of anomalies of the vertebrae has been dealt with in detail. This part is of great value, especially to those doing industrial medicine and surgery. The points of differential diagnosis in tuberculosis, arthritis, fractures, and tumors of the vertebra, are of great aid especially in obscure cases. I am sure careful study of these points will clear up obscure cases which are often of great importance as very frequently these patients are medico legal cases.

The reproductions are generally good, especially the lateral views which are always difficult to obtain. The book is well prepared and the material is arranged systematically. E L J

THE fourth edition of Hertzler's *Technic of Local Anesthesia*<sup>2</sup> has the good qualities of a monograph written on the basis of long experience with local methods. The book is completely up to date and is characterized by sane conservatism toward newer and more complicated methods which according to the author present rather a hope than an achievement. It is indeed highly constructive to read of the experiences, results and difficulties of such an experienced surgeon.

In the preparation of novocain solutions the author dissolves the unsterilized tablets in sterile water. Since the work of Hoffman and Kochmann on the sterility of novocain tablets this method may occasionally lead to infection. The use of quinine and urea for the prolongation of local anesthesia is given considerable space. It is a great credit to the author who for so many years has studied the action of quinine on the tissues to have restricted the usefulness of this drug to a limited field. Even so after personal experience the reviewer is not convinced of the harmlessness of quinine. Further work on the higher quinine derivatives may offer more promise in the future.

The printing and illustrations are excellent. For the general surgeon who does not always work under the most favorable circumstances this book will be a reliable guide to simple and safe methods.

Only such a combination as the surgeon himself administering the local anesthesia will ever lead to helpful and lasting results. The idea of making a specialty of local anesthesia is most aptly refuted by just such a contribution to the surgical literature as that of Hertzler.

GEORGE DE TAKATS

ANNALS OF ROENTGENOLOGY A SERIES OF MONOGRAPHIC ATLASES Edited by James T. Case, M.D. Vol. viii. The book is a roentgenologically Considered. By Arvid Wellington George, M.D. and Ralph D. Leonard, M.D. New York: Paul B. Hoeber, Inc. 1929.

THE TECHNIQUE OF LOCAL ANESTHESIA. By Arth. E. H. H. M.D. A.M. Ph.D., LL.D. F.A.C.S. 4th ed. St. Louis: The C.V. Mosby Company 1928.

WOLFF'S *Shorter Anatomy*<sup>3</sup> is written in the informal classroom style which characterizes a young, progressive, wide awake clinician. There is none of the carefully studied anatomical description with which we are familiar in the standard texts. The subject matter is divided into seven regions each region being taken up by systems. The descriptive matter is terse and to the point, at times even in outline form, but all clearly understandable. The illustrations are decidedly modernistic except for the omission of color although it is to be regretted that many are of decidedly inferior character and must detract somewhat from one's respect for the book. For purposes of rapid review or for use by the student of surgical anatomy the book would be of value. It would also recommend itself to the clinical teacher of surgery in his classroom work.

MICHAEL L. MASON

THIS book is the fruit of ten years of collaboration. With this statement Professors Leriche and Polcard introduce their compact monograph on the *Normal and Pathological Physiology of Bone*.<sup>4</sup> Drs. Moore and Key tell us, in the preface of their 236 page authorized translation of this work, that Professors Leriche and Polcard have surveyed the 'entire fund of knowledge pertaining to bone, condensed it, discarded that which was inaccurate and formed a synthesis of their study and observation which permits one to state the problems which are the foundation of bone physiology'. Footnotes are used to express the views of the translators when these differ from those of the original authors.

Osteogenesis is the problem of foremost interest, and after discussing it from many angles, Professors Leriche and Polcard the one surgeon and the other a professor of microscopic anatomy express the belief that we must look to the physicist and the chemist for the further solution of this problem.

Bone, they contend is only the end product of metaplasia or of a metamorphosis of connective tissue. The more adult the connective tissue, the less it is subject to metamorphosis to bone. And 'The physiological worth is inversely proportional to the histological differentiation'.

With V. Mueller they believe that when bone follows cartilaginous tissue the process is one of resorption of the cartilage and replacement first with connective tissue and finally with bone. They are convinced that the process is not a transformation and metaplasia but rather a substitution and neoplasia.

The rôle of the osteoblast is discussed at length, and the authors conclude that these cells do not have a true osteogenic function and that while alive they are weakly osteolytic. The osteoblasts which are hemmed in with pre-osseous substance become bone.

A SHORTER ANATOMY WITH PRACTICAL APPLICATIONS. By E. Wolff, M.B. B.S. (Lond.) F.R.C.S. (Eng.) New York: William Wood and Company 1929.

THE NORMAL AND PATHOLOGICAL PHYSIOLOGY OF BONE. ITS PROBLEMS. By R. Leriche and A. Polcard. Translated by Sherwood Moore, M.D., and J. Albert Key, M.D. St. Louis: The C.V. Mosby Company 1928.

cells but in this they have only a passive rôle. The authors are inclined to give credence to the theory of Robison which suggests that osteoblasts may secrete during life or liberate upon dying, substances which impregnate the fundamental pre-osseous substance and render it fit to fix lime salts.

Professors Leriche and Policard are convinced that calcification takes place in dead tissue and that 'new bone is built in part from the debris of old bone'. They propound the theory that resorption (rarefaction) of normal bone in the vicinity of a bone defect produces a local calcific surcharge essential to calcification in the new bone. Resorption of bone may be due to the phagocytic action of osteoclasts or to the process of osteolysis, or it may be a combination of the two processes.

The results of a series of experiments of their own have led the authors to consider the periosteum as a commonplace membrane which merely confines and limits bone growth and does not have any osteogenic function of its own.

Some most interesting observations are made under the headings of 'The Repair of Fractures', 'Bone Transplantations', 'Heterotopic Ossifications and Ossification and Pathology'.

Although many of the theories presented in this thesis will be challenged, the book should accomplish the purpose expressed by the authors and stimulate research in the directions in which they point. It is a book which should be read by all who are interested in problems of bone repair. D. B. PHEMISTER

## BOOKS RECEIVED

Books received are acknowledged in this department and such acknowledgment must be regarded as a sufficient return for the courtesy of the sender. Selections will be made for review in the interests of our readers and as space permits.

**TUBERCULOSIS ITS PREVENTION AND HOME TREATMENT A GUIDE FOR THE USE OF PATIENTS.** By H. Hyslop Thomson M.D. D.I.H. New York and London: Oxford University Press, 1928.

**THE CYTOARCHITECTONICS OF THE HUMAN CEREBRAL CORTEX.** By Constantin von Economo. Translated by Dr S. Parker. New York and London: Oxford University Press, 1929.

**DISEASES OF THE LARYNX INCLUDING THOSE OF THE TRACHEA, LARGE BRONCHI AND ESOPHAGUS.** By Harold Farwell M.B. (Lond.) F.R.C.S. (Eng.). New York and London: Oxford University Press, 1929.

**HEMORRHOIDS, THEIR ETIOLOGY, TROPHILAXIS AND TREATMENT BY MEANS OF INJECTIONS.** By Arthur S. Morley F.R.C.S. (Eng.). New York and London: Oxford University Press, 1929.

**NEPHRITIS ITS PROBLEMS AND TREATMENT.** By T. Izod Bennett M.D. (Lond.) F.R.C.P. New York and London: Oxford University Press, 1929.

**THE ROBERT JONES BIRTHDAY VOLUME A COLLECTION OF SURGICAL ESSAYS.** By Various Authors. New York and London: Oxford University Press, 1928.

**ESOPHAGEAL OBSTRUCTION ITS PATHOLOGY, DIAGNOSIS AND TREATMENT.** By A. Lawrence Abel M.S. (Lond.) F.R.C.S. (Eng.). New York and London: Oxford University Press, 1929.

**LA STÉRILISATION DE LA FEMME (ÉTUDE GÉNÉRALE).** By Doctor René Laurin. Alger: Heffer and Assant, 1929.

**LA COVITE GONOCOCCIQUE.** By Marthe Lamy. Paris: Gauthier Villars et Cie, 1929.

**ORTHOPEDIC SURGERY.** By Sir Robert Jones Bart. K.B.E. CH. CH. M. (Liverpool) F.R.C.S. (Eng. Ire. and Edin.) I.A.C.S. (USA.) and Robert W. Lovett, M.D. F.A.C.S. New York: William Wood & Company, 1929.

**ARCHIVOS DA FUNDACAO GAFFRÉE E GUINLE PUBLICADOS PELA TECHNICA.** Composta Dos Profs. Dr. Carlos Chagas e Dr. Ed. Fabello e Dr. G. da Moura Costa. Secretario Dr. Gastao Cruis. Rio de Janeiro: Fundacao Gaffrée Guinle, 1928.

**THE AMERICAN ILLUSTRATED MEDICAL DICTIONARY.** By W. A. Newman Dorland M.D., F.A.C.S. with the collaboration of E. C. L. Miller M.D. Philadelphia and London: W. B. Saunders Company, 1929.

**SURGICAL DISEASES OF CHILDREN, A MODERN TREATISE ON PEDIATRIC SURGERY.** By Samuel Walter Kelly M.D. LL.D. F.A.C.S. Vols. I and II. St. Louis: The C. V. Mosby Company, 1929.

**STONE AND CALCULUS DISEASE OF THE URINARY ORGANS.** By J. Swift Joly M.D. (Dub.), F.R.C. (Eng.). St. Louis: The C. V. Mosby Company, 1929.

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**THE PRINCIPLES OF ELECTROTHERAPY AND THEIR PRACTICAL APPLICATION.** By W. J. Turrell M.A. D.M. B.Ch. (Oxon.) D.M.R. & E. (Cantab.) and ed. New York: Oxford University Press, 1929.

**ARTIFICIAL SUNLIGHT AND ITS THERAPEUTIC USES.** By Francis Howard Humphris M.D. (Brux.) F.R.C.P. (Edin.) M.R.C.S. (Eng.) L.R.C.P. (Lond.) L.M. (Dublin) D.M.R. & E. (Cantab.) New York: Oxford University Press, 1929.

**GASTRO-INTESTINAL DISEASES.** Lectures delivered at the James Mackenzie Institute for Clinical Research, Andrews, Winter Session 1927. Edited by Professor David Waterston M.A. M.D. F.R.C.S. (Edin.) New York: Oxford University Press, 1928.

**KER'S INFECTIOUS DISEASES, A PRACTICAL TEXTBOOK.** Revised by Claude Rundle O.B.E. M.D. (Lond.) M.R.C.S. (Eng.) L.R.C.P. (Lond.) D.P.H. 3d ed. New York: Oxford University Press, 1929.

**THE TREATMENT OF FRACTURES AND DISLOCATIONS IN GENERAL PRACTICE.** By G. Mat Pape D.S.O. M.S. (Lond.) F.R.C.S. and W. Rowley Bristow M.B. B.S. (Lond.) F.R.C.S. New York: Oxford University Press, 1929.

**ENDOCRINE DISORDERS.** By Professor Hans Curchmann. With an Introduction by Franz Range. New York: Oxford University Press, 1929.

**METHODS AND PROBLEMS OF MEDICAL EDUCATION.** Thirteenth Series. By various authors. New York: The Rockefeller Foundation, 1929.

**VARIKOSE VEINS WITH SPECIAL REFERENCE TO THE INJECTION TREATMENT.** By H. O. McPheeters M.D. F.A.C.S. Philadelphia: F. A. Davis Company, 1929.

# CLINICAL CONGRESS OF AMERICAN COLLEGE OF SURGEONS

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## COMPLETE PROGRAM FOR THE CLINICAL CONGRESS IN CHICAGO

THE surgeons of Chicago are preparing and will present during the nineteenth annual Clinical Congress of the American College of Surgeons, beginning Monday, October 14th, and ending Friday, October 18th, a highly attractive program of clinics and demonstrations in the hospitals and medical schools of this city—one that will completely represent the clinical activities of this great medical center in all departments of surgery. A preliminary schedule of such clinics and demonstrations, as prepared by the Committee on Arrangements under the leadership of Dr. Herman L. Kretschmer, chairman, will be found in the following pages. The program as here published may be regarded as an outline of what the clinicians of Chicago intend to present as the hospital schedules will be further revised and amplified during the weeks preceding the Congress.

It will be noted that the program provides for operative clinics and demonstrations beginning at 2 o'clock on Monday afternoon, October 14th, and for each morning and afternoon of the four following days. The real clinical program will be used daily during the Congress: (1) in the form of bulletins to be posted on bulletin boards at headquarters each afternoon presenting an accurate and detailed schedule of the clinics and demonstrations to be given at each of the hospitals on the following day; (2) in the form of printed bulletins to be distributed each morning.

Since the last session of the Clinical Congress held in Chicago in 1923 a number of new hospitals have been built and some of the older

institutions have been remodeled and enlarged so that there has been a notable increase in Chicago's clinical facilities in keeping with the growth in population. Also, there has been a marked increase in hotel facilities so that it will be possible to accommodate comfortably a much larger number of visiting surgeons at this year's meeting than at any previous session in Chicago. The unusually large number of advance registrations already received at the offices of the College indicates a wide interest in the plans for this year's meeting.

In the clinical program special attention is to be given to the demonstration of modern methods in the treatment of fractures. A series of special fracture clinics will be held at the Cook County Hospital where members of the surgical staff of that institution will give fracture clinics daily. Under the auspices of the College Committee on Fractures, a special series of clinics and demonstrations is being arranged for Tuesday and Wednesday afternoons at Cook County Hospital at which clinics several members of the Committee living outside of Chicago have been asked to participate and demonstrate special methods used in the more difficult fracture cases.

In addition to an attractive program of clinics and demonstrations in the hospitals and medical schools provided by the ophthalmologists and otolaryngologists, covering all phases of surgical work in these specialties the officers of the Chicago Ophthalmological and Chicago Laryngological societies have arranged for a joint session with a dinner on Wednesday evening at the Stevens Hotel to which are invited all those

cells, but in this they have only a passive rôle. The authors are inclined to give credence to the theory of Robison which suggests that osteoblasts may secrete during life or liberate upon dying substances which impregnate the fundamental pre-osseous substance and render it fit to fix lime salts.

Professors Leriche and Policard are convinced that calcification takes place in dead tissue and that new bone is built in part from the debris of old bone. They propound the theory that resorption (rarefaction) of normal bone in the vicinity of a bone defect produces a local calcific surcharge essential to calcification in the new bone. Resorption of bone may be due to the phagocytic action of osteoclasts or to the process of osteolysis, or it may be a combination of the two processes.

The results of a series of experiments of their own have led the authors to consider the periosteum as a commonplace membrane which merely confines and limits bone growth and does not have any osteogenic function of its own.

Some most interesting observations are made under the headings of 'The Repair of Fractures

Bone Transplantations', 'Heterotopic Ossifications', and 'Ossification and Pathology'.

Although many of the theories presented in this thesis will be challenged the book should accomplish the purpose expressed by the authors and stimulate research in the directions in which they point out knowledge needs to be gained. It is a book which should be read by all who are interested in problems of bone repair.

D B. PREMITER

## BOOKS RECEIVED

Books received are acknowledged in this department and such acknowledgment must be regarded as a sufficient return for the courtesy of the sender. Selections will be made for review in the interests of our readers and as space permits.

**TUBERCULOSIS ITS PREVENTION AND HOME TREATMENT A GUIDE FOR THE USE OF PATIENTS.** By H. Hyalop. Thomson M.D. D.P.H. New York and London: Oxford University Press 1928.

**THE CYTOARCHITECTONICS OF THE HUMAN CEREBRAL CORTEX.** By Constantin von Economo. Translated by Dr S. Parker. New York and London: Oxford University Press 1929.

**DISEASES OF THE LARYNX INCLUDING THOSE OF THE TRACHEA, LARGE BRONCHUS AND ESOPHAGUS.** By Harold Farwell M.B. (Lond.) F.R.C.S. (Eng.) New York and London: Oxford University Press 1929.

**HEMORRHOIDS THEIR ETIOLOGY, PROPHYLAXIS AND TREATMENT BY MEANS OF INJECTIONS.** By Arthur S. Morley F.R.C.S. (Eng.) New York and London: Oxford University Press 1929.

**NEPHRITIS ITS PROBLEMS AND TREATMENT.** By T. Izod Bennett M.D. (Lond.) F.R.C.P. New York and London: Oxford University Press 1929.

**THE ROBERT JONES BIRTHDAY VOLUME A COLLECTION OF SURGICAL ESSAYS.** By Various Authors. New York and London: Oxford University Press 1928.

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attending the Congress who are interested in these specialties. Mr Herbert Tilley, of London one of the outstanding otolaryngologists of Great Britain will speak on "The Tonsils and Some Experiences of Their Surgical Treatment," and Dr Harold Gifford, of Omaha, on "Clinical Miscellany." Major Norman Imrie, instructor in American history at the Culver Military Academy will talk on "Here and There."

In addition to the clinics and demonstrations to be given by the surgeons of Chicago, a series of special clinical demonstrations has been arranged for Tuesday and Wednesday afternoons to be given in the ballroom of the Stevens Hotel. A complete detailed program for these sessions will be found in the following pages.

An important feature of this year's Congress will be the showing of a number of surgical films that have been produced under the supervision of and approved by the Board on Medical Motion Picture Films. Several such films will be given their premier showing in Chicago. A rather extensive program of motion picture films to include other surgical films is planned.

Among the distinguished guests of the Clinical Congress who will be introduced at the Monday evening session are Dr D P D Wilkie, professor of surgery in the University of Edinburgh, Scotland. Professor James Heyman, one of the active staff members of the Radiumhemmet, Stockholm, Sweden. Dr T de Martel, an eminent surgeon of Paris, France. Dr Florestan Aguilar, physician in ordinary to the King of Spain and member of the faculty of the University of Madrid.

#### HEADQUARTERS

General headquarters for the Congress will be established at the Stevens Hotel, located on Michigan Avenue between Seventh and Eighth Streets, where the grand ballroom, other smaller ballrooms and large public rooms on the second, third, and fourth floors have been reserved for the exclusive use of the Congress for scientific meetings, hospital conferences, motion picture exhibitions, committee rooms, executive offices, etc. The registration desk will be located in the large exhibition hall at the south end of the hotel in which room will also be found the bulletin boards, ticket bureaus, and the scientific and technical exhibits. All of the evening meetings are to be held in the grand ballroom which will also be used for the hospital conferences on Monday, clinical demonstrations on Tuesday and Wednesday afternoons, the annual meeting on Thursday afternoon and the conferences on traumatic surgery on Friday morning and afternoon.

#### EVENING MEETINGS

The complete programs for the five evening sessions as arranged by the Executive Committee of the Clinical Congress will be found in the following pages. All of these meetings will be held in the grand ballroom of the Stevens Hotel. At the Presidential Meeting on Monday evening the president-elect, Major General Merritt W. Ireland, surgeon general of the United States Army, will be inaugurated and will deliver the annual address. The Murphy oration in surgery will be delivered on the same evening by Professor D P D Wilkie of Edinburgh, Scotland. At the Convocation on Friday evening, the Fellowship address will be delivered by Dr Glenn Frank, president of the University of Wisconsin.

#### HOSPITAL CONFERENCE

The twelfth annual hospital conference of the American College of Surgeons opens on Monday morning at 9:30 in the grand ballroom of the Stevens Hotel with an afternoon session in the same room. On the following days the sessions will all be held in the north ballroom on the third floor. The complete program for the conference is published in the following pages. It provides an interesting series of papers, discussions, round table conferences, and demonstrations dealing with many of the problems related to hospital efficiency and is planned to interest not only surgeons but hospital trustees and personnel generally. An invitation to attend is extended to all persons who are interested in hospital activities. Also, all persons attending the conference are urged to avail themselves of the other activities of the Congress, especially to attend the Presidential Meeting on Monday evening and the Convocation on Friday evening.

#### ANNUAL MEETING—CANCER SYMPOSIUM

The annual meeting of the Fellows of the College will be held at 2 o'clock on Thursday afternoon in the grand ballroom at which time reports of officers and committees will be presented and officers elected for the following year. Immediately following the business session there will be presented the following group of papers:

- ROBERT B GREENOUGH, M.D., Boston, Chairman of the Committee. Report of the Committee on the Treatment of Malignant Diseases with Radium and X-Ray.  
 BURTON J LEE, M.D., New York. The Incidence of Cancer in the Indians of the Southwest.  
 EMIL NOVAK, M.D., Baltimore. The Early Recognition of Cervical Cancer.  
 DALLAS B. PHEMISTER, M.D., Chicago. Chairman, Committee on Bone Sarcoma. Chondrosarcoma of Bone.  
 BOWMAN C. CROWELL, M.D., Chicago. Summary of Ewing's sarcoma in the Register.

## CONFERENCE ON TRAUMATIC SURGERY

A conference on traumatic surgery has been arranged for Friday with sessions both morning and afternoon in the grand ballroom of the Stevens Hotel to which leaders in industry, education, and labor together with representatives of indemnity companies, surgeons, and hospital administrators have been asked to contribute. The program for the conference is as follows:

## MORNING SESSION

- FREDERIC A. BESLEY, M.D., Waukegan, Chairman, Board on Traumatic Surgery, presiding.  
 BOWMAN C. CROWELL, M.D., Chicago, Secretary, Board on Traumatic Surgery. Summary of Past and Future Activities of the Board on Traumatic Surgery.  
 FREDERICK W. SLODGE, M.D., Chicago, Relation of the Doctor to Industry, Hospitals and Indemnity Companies.  
 C. F. N. SCHRAM, M.D., Beloit, Wis., President, American Association of Industrial Physicians and Surgeons. Present Status and Qualifications of the Industrial Surgeon.  
 C. H. WATSON, M.D., New York, Medical Director, American Telephone and Telegraph Company. Pre-employment and Periodic Health Examinations in Industry.  
 VOLNEY S. CHENEY, M.D., Chicago, Medical Director, Armour & Co. Organization of an Industrial Medical Department.  
 GEORGE G. DAVIS, M.D., Chicago, Chief Surgeon, Illinois Steel Company. Transportation of the Injured.  
 Discussion, W. E. DEEKS, M.D., New York, General Manager, Medical Department, United Fruit Company.  
 CLARENCE D. SELBY, M.D., Toledo, Ohio, Group Medical Service for Small Industries.  
 IRVIN ABELL, M.D., Louisville, Professor of Clinical Surgery, University of Louisville. Traumatic Surgery in the Curriculum of Medical Schools.  
 HERBERT C. CLARK, M.D., Panama, Director, Gorgas Memorial Laboratory. Industrial Research in the Tropics.  
 HART L. FISHER, M.D., Chicago, Chief Surgeon, Chicago Rapid Transit Company. Exhibit of Resuscitation.

## AFTERNOON SESSION

- FRANKLIN H. MARTIN, M.D., Chicago, Director General, American College of Surgeons. Inspiration and Ideals of the Board on Traumatic Surgery.  
 E. W. WILLIAMSON, M.D., Chicago, Investigator for the Board on Traumatic Surgery. Summary of Surveys Made by the Board on Traumatic Surgery.  
 Representation of the American Federation of Labor. Labor's Attitude Toward Industrial Surgery.  
 I. HIGHLAND BYRNS, Baltimore, President, Maryland Casualty Company, and JAMES S. KEMPER, Chicago, President, Lumbermen's Mutual Casualty Company. The Medical Department in Indemnity Companies—Its Value and Its Needs.  
 LINDSAY ROGERS, New York, Professor of Public Law, Columbia University. Medicine and Compensation Laws.  
 FREDERIC A. BESLEY, M.D., Waukegan, Chairman, Board on Traumatic Surgery. How the Program of the Board on Traumatic Surgery Accommodates Itself to the Above Problems.

## REDUCED RAILWAY FARES

The railways of the United States and Canada have authorized reduced fares on account of the Chicago session of the Clinical Congress so that the total fare for the round trip will be one and one half the ordinary first class one way fare. To take advantage of the reduced rates it is necessary to pay the full one way fare to Chicago, procuring from the ticket agent when purchasing ticket, a "convention certificate," which certificate is to be deposited at headquarters for the use of a special agent of the railways. Upon presentation of a valid certificate to the ticket agent in Chicago not later than October 30th a ticket for the return journey by the same route as traveled to Chicago may be purchased at one half the one way fare.

In the eastern, central, and southern states and eastern provinces of Canada, tickets may be purchased between October 10th and 18th in south western and western states between October 9th and 17th, and in the far western states and western provinces of Canada between October 6th and 14th. The return journey from Chicago must be begun not later than October 30th.

The reduction in fares does not apply to Pullman fares nor to extra fares charged for passage on certain trains. Local railroad ticket agents will supply detailed information with regard to dates of sale, rates, routes, etc. Stop-overs on both the going and return journeys may be had within certain limits.

Full fare must be paid from starting point to Chicago, and it is essential that a "convention certificate" be obtained from the agent from whom the ticket is purchased. These certificates are to be signed by the general manager of the Clinical Congress and used by a special railroad agent in Chicago during the meeting. No reduction in railroad fares can be secured except in compliance with the regulations outlined and within the dates specified. It is important to note that the return trip must be made by the same route as that used to Chicago and that the certificate must be deposited at headquarters during the meeting and return ticket purchased and used not later than October 30th.

It will be noted that the arrangement outlined above, extending the return limit to October 30th, allows for an additional twelve days following the close of the Clinical Congress, thus providing an opportunity for visiting other clinical centers in the middle west.

An exception to the above arrangement is to be noted in the case of persons traveling from points in certain far western states and British Columbia, who will be able to purchase round trip summer

excursion tickets which will be on sale up to and including September 30th with a final return limit of October 31st. The summer excursion fare is somewhat lower than the convention fare mentioned above but is available only, in certain of the far western states and British Columbia. Tickets sold at summer excursion rates permit traveling to Chicago via direct route and returning via another direct route with liberal stop-over privileges.

#### LIMITED ATTENDANCE

Attendance at the Chicago session will be limited to a number that can be comfortably accommodated at the clinics. The limit of attendance being based upon the result of a survey of the amphitheatres, operating rooms, and laboratories in the hospitals and medical schools to determine their capacity for accommodating visitors. Under this plan it will be necessary for those who wish to attend to register in advance.

Attendance at all clinics and demonstration will be controlled by means of special clinic tickets, which plan provides an efficient means for the distribution of the visiting surgeons among the several clinics, and insures against over crowding as the number of tickets issued for any clinic will be limited to the capacity of the room in which that clinic will be given. Clinic tickets will be distributed each morning and may be reserved late on the previous day.

#### REGISTRATION FEE

A registration fee of \$5.00 is required of each surgeon attending the annual Clinical Congress, such fees providing the funds with which to meet

the expenses of the meeting. To each surgeon registering in advance a formal receipt for the registration fee is issued, which receipt is to be exchanged for a general admission card at headquarters. This card which is non transferable must be presented to secure clinic tickets and admission to the evening meeting.

#### CHICAGO HOTELS AND THEIR RATES

In recent years a number of fine large hotels have been built in Chicago, among which is the Stevens with its 3000 guest rooms. Ample first class hotel facilities are available, many of the hotels being located within short walking distance of the headquarters hotel.

	Minimum Rates with Bk & Bag		Single Room	Double Room
Auditorium Michigan Ave and Congress St	\$3.50	\$5.00		
Belmont 3100 Sheridan Road	4.00	5.00		
Bismarck 175 W. Randolph St.	3.50	5.00		
Blackstone Michigan Ave and East 7th St	5.00	10.00		
Chicago Beach 1665 Hyde Park Blvd	5.00	5.00		
Congress Michigan Ave and Congress St.	4.00	6.00		
Drake Michigan Ave and Walton Place	5.00	6.00		
Edgewater Beach 5349 Sheridan Road	4.00	6.00		
Fort Dearborn Van Buren and LaSalle Sts.	7.00	3.00		
Great Northern Jackson Blvd and Dearborn	3.50	4.50		
Knickerbocker 163 E. Walton Place	3.00	5.00		
Lake Shore Drive 181 Lake Shore Drive	5.00	7.00		
LaSalle LaSalle and Madison Sts	3.00	4.00		
Morrison Clark and Madison Sts	2.50	3.00		
Palmer Monroe and State Sts.	4.00	7.00		
Larkway 2100 Lincoln Park West	3.00	5.00		
Pearson St. Clair and Pearson Sts	3.00	5.00		
Sherman Clark and Randolph Sts	3.00	4.00		
Stevens Michigan Ave and 7th St	3.00	6.00		
Webster 2150 Lincoln Park West	3.00	5.00		

### CLINICAL DEMONSTRATIONS

*Tuesday, 2 P M —Grand Ballroom Stevens Hotel*

J. M. T. FINNEY, M.D. Baltimore Surgery of the stomach  
BURTON J. LEE, M.D. New York Tumors of the breast  
CHARLES H. MAJO, M.D. Rochester, Minn. Laws of cell growth

*Wednesday 2 P M —Grand Ballroom Stevens Hotel*

GEORGE W. CRILE, M.D. Cleveland Influence of the thyroid and of the adrenals in the production and treatment of peptic ulcer  
WALTER E. DANDY, M.D. Baltimore Brain surgery  
JOHN B. DEEVER, M.D., Philadelphia Abdominal surgery

## PROGRAM FOR EVENING MEETINGS

*Presidential Meeting—Monday, 8 15 P M—Grand Ballroom, Stevens Hotel*

Address of Welcome HERMAN L KRETSCHMER, M D, Chicago, Chairman of Committee on Arrangements

Address of Retiring President FRANKLIN H MARTIN M D, Chicago

Introduction of Foreign Guests

Inaugural Address Surgery in the Medical Department of the United States Army MAJOR GENERAL MERRITTE W IRELAND, Washington

The John B. Murphy Oration in Surgery Some Principles in Abdominal Surgery PROFESSOR D P D WILKIE, Edinburgh, Scotland

*Tuesday 8 15 P M—Grand Ballroom Stevens Hotel*

FRANK H LAHEY M D, Boston Hyperthyroidism Associated with Cardiac Disorders

Discussion H M RICHTER M D and OSCAR NADEAU M D, Chicago

EDWARD W ARCHIBALD, M D Montreal Dangers Involved in the Operation of Thoracoplasty for Pulmonary Tuberculosis

Discussion CARL A HEDBLOM M D and RALPH B BETTMAN, M D, Chicago

WALTMAN WALTERS M D, Rochester, Minn A Method of Reducing the Incidence of Fatal Post operative Pulmonary Embolism

Discussion EDWIN M MILLER M D and VERNON C DAVID, M D Chicago

*Wednesday 8 15 P M—Grand Ballroom Stevens Hotel*

JAMES HEYMAN, M D Stockholm Sweden Radiology as a Complete or Partial Substitute for Surgery in the Treatment of Cancer of the Female Pelvic Organs

Discussion ARTHUR H CURTIS M D and HENRY SCHMITZ M D Chicago

WILLIAM B HOLDEN M D, Portland Oregon The Surgical Treatment of Intestinal Obstruction

Discussion FREDERIC A BESLEY M D J A WOLFER M D and L R DRASTEDT M D, Chicago

CHARLES L SCUDDER, M D Boston Oration on Fractures

*Thursday, 8 15 P M—Grand Ballroom Stevens Hotel*

THIERRY DE MARTEL M D, Paris France The Status of Local Anæsthesia in Neurologic Surgery

Discussion ALLEN B KANAVEL M D and LOYAL DAVIS M D, Chicago

A W ADSON M D Rochester Minn Surgical Indications for Sympathetic Ganglionectomy and Trunk Resection in the Treatment of Chronic Arthritis (In collaboration with LEONARD G ROWNTREE M D)

Discussion LEWIS J POLLOCK M D and STEPHEN W RANSON, M D Chicago

Symposium Pernicious Anæmia

GEORGE H WHIPPLE M D Rochester N Y Physiological Background of the Treatment of Pernicious Anæmia by Diet Factors

C C STURGIS M D Ann Arbor Mich The Treatment of Pernicious Anæmia by Liver Feeding

WILLIAM P MURPHY M D Boston Newer Developments of Liver Feeding in Cases of Anæmia Liver Feeding in Diseases of the Liver

Discussion CHARLES A FELLIOTT M D and A C IVY M D Chicago

*Convocation—Friday 8 15 P M—Grand Ballroom, Stevens Hotel*

Conferring of Honorary Fellowships

Presentation of Candidates for Fellowship Class of 1929

Presidential Address The Medical Department of the United States Army MAJOR GENERAL MERRITTE W IRELAND Washington

Fellowship Address DR. GLENN FRANK President of the University of Wisconsin Madison

## PRELIMINARY CLINICAL PROGRAM

## GENERAL SURGERY, GYNECOLOGY, OBSTETRICS, UROLOGY, ORTHOPEDICS

PASSAVANT MEMORIAL HOSPITAL—NORTH  
WESTERN UNIVERSITY MEDICAL SCHOOL*Monday*

- 2—Symposium on Diseases of the Liver and Bile Passages  
 CHARLES A ELLIOTT Some medical aspects of biliary disease  
 WALTER H NADLER Hypoglycemia of hepatic origin associated with primary liver cell carcinoma  
 PAUL STARR Practical methods of determination of liver function.  
 J T HART and R C CRAIG The spinal cord pathway of afferent impulses from the gall bladder  
 J R BUCHSINDER Surgical indications in the doubtful gall bladder  
 JAMES T CASE An evaluation of cholecystography based upon findings at operation  
 F I WALKER and A C IVY Studies on the solubility of human gall stones bearing on the etiology

*Tuesday*

- H M RICHTER—9 Cholecystectomy, cholelithiasis  
 LOYAL DAVIS—9 Trigeminal neuralgia  
 A H CURTIS and G H GARDNER—9 Operative gynecology  
 2—Symposium on the Diagnosis and Surgical Treatment of Diseases affecting Muscle Function  
 S W RANSOM Studies in muscle tone  
 L J POLLOCK Muscle tone in Parkinsonian states.  
 LOYAL DAVIS The surgical treatment of Parkinson's disease

*Wednesday*

- ALLEN B KANAVEL—9 Thyroid surgery  
 J R BUCHSINDER—9 Thyroid surgery  
 2—Symposium on Diseases of the Thyroid Gland  
 J G CARR Cardiac disease associated with hyperthyroidism  
 C A ELLIOTT The management of patients with hyperthyroidism  
 H M RICHTER The surgical indications in hyperthyroidism  
 LAWRENCE JACQUES Irradiated ergosterol in the treatment of postoperative tetany  
 ALLEN B KANAVEL and J J LEBOWITZ The late results of thyroidectomy

*Thursday*

- H M RICHTER—9 Thyroid surgery  
 LOYAL DAVIS—9 Brain tumor  
 A H CURTIS and G H GARDNER—9 Operative gynecology  
 2—Symposium on Surgery of the Hand  
 ALLEN B KANAVEL Presentation of cases—tendon suture arthroplasty Dupuytren's contraction tenoplasty  
 M L MASON and C G SHERSON Tendon suture—an experimental study  
 SUMNER L KOCH Acquired contractures of the hand

*Friday*

- ALLEN B KANAVEL—9 Dupuytren's contraction.  
 SUMNER L KOCH and M L MASON—9 Tendon transplantation  
 (Note—Morning clinics at Passavant Memorial Hospital, afternoon clinics at Northwestern University Medical School)

## ALBERT MERRITT BILLINGS HOSPITAL

*Monday*

- LESTER DRAGSTEDT—2 Abdominal surgery intestinal obstruction

*Tuesday*

- PERCIVAL BAILEY—9 Surgery of the spinal cord  
 D B FLEMISTER L DRAGSTEDT G M CURTIS and C B HUGGINS—9 Surgical operations.

*Wednesday*

- D B FLEMISTER—9 Surgery of bones and joints.  
 P BAILEY G M CURTIS L DRAGSTEDT and C B HUGGINS—9 Surgical operations

*Thursday*

- G M CURTIS—9 Surgery of the thyroid.  
 D B FLEMISTER P BAILEY, L DRAGSTEDT and C B HUGGINS—9 Surgical operations

*Friday*

- C B HUGGINS—9 Genito-urinary surgery  
 D B FLEMISTER P BAILEY G M CURTIS and L DRAGSTEDT—9 Surgical operations.

## RESEARCH AND EDUCATIONAL HOSPITAL

*Tuesday*

- CARL A. HEDBLUM—10 Thoracic and general surgery

*Wednesday*

- JEROME R. HEAD—10 Neurological surgery  
 J H FALLS—2 Gynecology and obstetrics  
 H B THOMAS—2 Orthopedic surgery

*Thursday*

- J D KOUCKY—10 General surgery  
 CHARLES MCKENNA—2 Genito-urinary surgery

*Friday*

- LINDON SEED—9 Thyroid surgery  
 LOUIS SCHULZE—10 Oral surgery  
 F H FALLS—2 Gynecology and obstetrics

## CHICAGO LYING-IN HOSPITAL

*Monday*

- JOSEPH B DEFLER—2 Motion pictures of laparoscopic chelotomy

*Tuesday*

- D A HORNER and L E NADENHOFF—9 Obstetrical clinic.  
 A R LAPHAM—2 Obstetrical clinic.

*Wednesday*

- J P GREENHILL and M E DAVIS—9 Obstetrical clinic

*Thursday*

- C L CORNELL and M P LANE—9 Obstetrical clinic

*Friday*

- J H. BLOOMFIELD and H BURBAUM—9 Obstetrical clinic

### COOK COUNTY HOSPITAL (including the Children's Hospital)

#### Monday

SUMNER L. KOCH—Surgery of the hand—general surgery  
 GEORGE L. APPELBACH—Surgical complications of diabetes  
 FREDERICK G. DYAS—Thyroid disease—carcinoma of the breast  
 FREDERICK FALLS—Obstetrical operations  
 GEORGE DAVENPORT—General surgery  
 FRANK JIRKA—General surgery  
 PAUL OLIVER—General surgery  
 CHARLES PARKER—General surgery

#### Tuesday

HARRY CULVER—Genito-urinary surgery  
 CHARLES M. MCKENNA—Urological clinic  
 R. W. MCNEALY—General surgery  
 KELLOGG SPEED—Tumors of bone—fractures of carpal bones  
 HARRY JACKSON—Injuries to the brain  
 D. C. STRAUSS—Thyroid surgery  
 R. T. VAUGHAN—General surgery  
 EDWARD M. MILLER—Toxic thyroid disease in children—purpura hemorrhagica  
 RICHARD JAFFE—11—Pathological conference  
 CHARLES L. SCUDDER (Boston)—M. S. HENDERSON (Rochester)—W. C. CAMPBELL (Memphis)—P. D. WILSON (Boston)—2—Fracture clinic

#### Wednesday

HENRY SCHMITZ—Inflammation of the pelvic organs—carcinoma of the pelvic organs  
 PHILIP H. KREUSCHER—Osteomyelitis—congenital deformities—arthroplasty of hip and elbow  
 V. L. SCHRAGER—General surgery  
 SUMNER L. KOCH—Surgery of the hand—general surgery  
 J. R. BUCHINDER—Thyroid surgery  
 WILLIAM O. NEILL SHERMAN (Pittsburgh)—E. L. ELIASON (Philadelphia)—COL. W. E. KELLER (Washington)—FRED C. COTTON (Boston)—2—Fracture clinic

#### Thursday

CHANNING W. BARRETT—Gynecological clinic  
 KARL A. MEYER—Gastric surgery  
 WILLIAM R. CUBBINS—Fracture clinic  
 CHARLES DAVISON—General surgery  
 JOHN R. HARGER—Acute osteomyelitis  
 D. S. HILLIS—Obstetrical clinic  
 A. F. LASH—Treatment of puerperal infection  
 EDWARD M. MILLER—Fractures about the elbow in children  
 RICHARD JAFFE—11—Pathological conference

#### Friday

CAREY CULBERTSON—Gynecological clinic  
 VERNON C. DAVID—Carcinoma of large bowel  
 GEORGE DE TARNSKY—General surgery  
 J. R. BUCHINDER—General surgery  
 A. E. KANTER—Gynecological operations  
 E. L. CORNELL—Complications of pregnancy and labor  
 FREDERICK G. DYAS—Thyroid disease—carcinoma of the breast  
 FREDERICK FALLS—Obstetrical clinic

#### Days and Hours to Be Announced

PHILIP LEWIN—CHARLES PARKER—DANIEL LEVINthal—FREDERICK TEST—MARCUS HOBART—PHILIP H. KREUSCHER—Orthopedic operations and demonstration of cases.

### GARFIELD PARK HOSPITAL

#### Monday

J. M. BERGER—2—Thyroid clinic—operations and demonstration of cases  
 J. R. HARGER—2—Bone transplant—nerve and tendon suture  
 CARL BAUER—3—Diagnosis and management of sterility—radium treatment of carcinoma of the cervix  
 P. S. SCHMITT—3—Pathological presentations

#### Tuesday

FRANK D. MOORE—9—Surgery of the upper abdomen  
 THEODORE TEIKEN—9—The medical aspects of the abdominal case  
 F. L. BROWN—2—Gall bladder surgery

#### Wednesday

C. C. ROGERS—9—Operative treatment of cranial injuries  
 L. F. MACDIARMID—9—Surgery of the abdomen  
 VINCENT J. O'CONNOR—2—Two stage suprapubic prostatectomy  
 B. F. EDWARD MOORE—2—Orthopedic surgery

#### Thursday

VICTOR SCHRAGER—2—Surgical treatment of ulcer of the stomach  
 C. WELBY—2—Surgery of the gall bladder  
 R. H. GOOD—2—Thoracic surgery

#### Friday

G. G. FOUSER—9—Surgery of the thyroid  
 H. L. BAKER—9—Abdominal surgery  
 H. N. WATT—9—Roentgenology

### ILLINOIS CENTRAL HOSPITAL

#### Tuesday

HUGH MACKECHNIE—9—Dry clinic—General surgery  
 CHARLES H. PRIFER—10—Infections of the upper abdomen  
 FARIS CHESLEY—11—Medical aspects of the acute abdomen

#### Wednesday

W. T. HARSHA—9—Dry clinic—General surgery  
 LEROY H. SLOAN—10—Medical aspects of toxic goiter  
 A. H. BAUGHER—11—Pathology of toxic goiter

#### Thursday

J. C. DELPRAT—9—Dry clinic—General surgery  
 STEPHEN C. HOGAN—10—Gynecological clinic  
 WILLIAM CULPEPPER—11—X-ray demonstration of pathology of Paget's disease—leues and metastatic tumors

#### Friday

W. T. HARSHA and C. C. GUY—9—Dry clinic—General surgery  
 REVERIDGE MOORE—10—Orthopedic surgery  
 WILLIAM HEWITT—11—Dry clinic—Gynecology and obstetrics

### WASHINGTON BOULEVARD HOSPITAL

#### Tuesday

ARTHUR R. METZ—9—Fracture clinic.

#### Wednesday

VINCENT J. O'CONNOR—9—Urological clinic.

#### Thursday

PALL C. FOX—9—Gynecological clinic

## PRESBYTERIAN HOSPITAL

## Tuesday

- A D BEVAN and associates—9 General surgical operations  
 A D BEVAN DR GATEWOOD and R C BROWN—9 Gall bladder surgery  
 HERMAN L KRETSCHMER—9 Urological surgery  
 R H HERBST—9 Urological surgery  
 V C DAVID—9 General surgical operations  
 CARL DAVIS—9 General surgical operations  
 N SPROAT HEANEY CAREY CULBERTSON A E KANTER E D ALLEN and C P BAUER—9 Gynecological and obstetrical clinics  
 W C THOMAS—10 30 Blood chemistry and postoperative care  
 A D BEVAN DR DAVIS, and V C DAVID—Surgery of the large bowel  
 A H MONTGOMERY—12 Intussusception

## Wednesday

- A D BEVAN and associates—9 General surgical operations  
 HERMAN L KRETSCHMER—9 Urological surgery  
 N SPROAT HEANEY CAREY CULBERTSON A E KANTER E D ALLEN and C P BAUER—9 Gynecological and obstetrical clinics  
 WILBER POST—10 30 Medical preparation of poor surgical risks for surgery  
 KELLOGG SPEED—11 General surgical operations Knee joint cases.  
 E MILLER—9 General surgical operations.  
 A D BEVAN DR DAVIS L M MILLER and DR LORING—11 Surgery of the thyroid  
 ISABELLE HERBST—11 40 Anesthesia in gaster surgery

## Thursday

- A D BEVAN and associates—9 General surgical operations  
 HERMAN L KRETSCHMER—9 Urological surgery  
 R H HERBST—9 Urological surgery  
 V C DAVID—9 General surgical operations.  
 KELLOGG SPEED—9 Bone surgery  
 E M MILLER—9 Posterior dislocation of the shoulder  
 A H PARNELLE—9 Diagnosis of acute osteomyelitis  
 V C DAVID—9 Regeneration of bone in osteomyelitis  
 R C WOODYATT—9 Preparation of diabetics for surgery  
 GEORGE F DICK—9 Frysipelas  
 I ETER BASSOE and W J POTTS—9 Charcot joints  
 A H MONTGOMERY—9 Treatment of burns  
 N SPROAT HEANEY CAREY CULBERTSON A E KANTER E D ALLEN and C P BAUER—9 Gynecological and obstetrical clinics  
 H A OBERHELMAN—11 Surgical pathology

## Friday

- A D BEVAN and associates—9 General surgical operations  
 A D BEVAN DR GATEWOOD R C BROWN D P ABBOTT and C G GRULKE—9 Surgery of the stomach  
 HERMAN L KRETSCHMER—9 Urological clinic  
 CARL DAVIS—9 General surgical operations  
 N SPROAT HEANEY CAREY CULBERTSON A E KANTER E D ALLEN and C P BAUER—9 Gynecological and obstetrical clinics.  
 E E IRONS—10 30 Relation of focal infection to surgery  
 DR. GATEWOOD—11 Subphrenic abscess.  
 FREDERICK MOOREHEAD—11 20 Surgery of the mouth and face

## ST JOSEPH'S HOSPITAL

## Tuesday

- FRANK DAVID and C J DEBERE—9 Rectal surgery  
 W H G LOCAN—9 Oral surgery  
 CHARLES M MCKENNA—9 Genito-urinary surgery  
 HUGH MCKENNA OSCAR O'NEER DAVID FITZGERALD and GEORGE FITZGERALD—9 General surgery  
 CHARLES SCHOTT—9 Results of Rammstedt operation for pyloric stenosis in infants

## Wednesday

- FRANK DAVID and C J DEBERE—9 Rectal surgery  
 F B MCCARTY E J CARROLL and JOHN BOLAND—9 General surgery  
 W F GROSVENOR H BUXBAUM L W MARTIN T J O'DONOGHUE F W ROHR and G COTTS—11 Gynecology

## Thursday

- FRANK DAVID and C J DEBERE—9 Rectal surgery  
 W H G LOCAN—9 Oral surgery  
 CHARLES M MCKENNA—9 Genito-urinary surgery  
 HUGH MCKENNA OSCAR O'NEER DAVID FITZGERALD and GEORGE FITZGERALD—9 General surgery  
 L L HINES—9 Demonstration of laboratory work as applied to surgery

## Friday

- F B MCCARTY E P CARROLL and JOHN BOLAND—9 General surgery  
 W F GROSVENOR H BUXBAUM L W MARTIN T J O'DONOGHUE F W ROHR and G COTTS—11 Gynecology

## SPECIAL FRACTURE CLINICS

(At Cook County Hospital Arranged by the Committee on the Treatment of Fractures)

## Tuesday

- CHARLES L SLUDDES Boston (Chairman of Committee)—1 The aims and work of the Fracture Committee  
 M S HENDERSON Rochester Minn—2 30 Non union after fracture massive bone graft lantern slide demonstration and patients.  
 W C CAMPBELL Memphis Tenn—3 30 Reduction by closed manipulation of fracture of the shaft of the femur two cases  
 P D WILSON Boston—4 15 Operation Subastragular arthrodesis for fracture of the os calcis.

## Wednesday

- FRED C COTTON Boston—2 Artificial impaction for fracture of neck of femur two cases  
 WILLIAM O'NEIL SHERMAN Pittsburgh—3 45 Plating for fracture of shaft of femur  
 E L ELLISON Philadelphia—3 30 Pathologic fractures  
 COLONEL W E KELLER Washington—4 Old fracture dislocation at the shoulder

## RUSH MEDICAL COLLEGE

## Tuesday

- CARL DAVIS—11 Surgical clinic

## Wednesday

- N S HEANEY—11 Gynecological clinic

## Thursday

- A D BEVAN—11 Surgical clinic

## Friday

- CARL DAVIS—11 Surgical clinic.

## WESLEY MEMORIAL HOSPITAL

## Monday

M T GOLDSTINE—2 Hysterectomy vaginal plastics

## Tuesday

G DE TAKATS—9 Exclusion of tail of pancreas in diabetes thyroidectomy local anesthesia

CUTY S VAN ALSTYNE—9 General surgery

LOYAL DAVIS— Brain surgery

## Wednesday

R W McNEALY—9 Hernia and blood vessel surgery

ALLEN B KANAVEL—9 General surgery

JOHN A WOLFER—9 Duodenal stasis and periduodenitis

I B MAGNUSON and WILLIAM A HENDRICKS—2 Plastic on hip spinal fusion

## Thursday

ALLEN B KANAVEL—9 General surgery

EUGENE B FERRY—9 Cystoplasties and kidney surgery

O S PAVLIK—10 Hysterectomy and ovarian transplantation

A D LESPINASSE—2 Genito-urinary surgery

## Friday

R W McNEALY—9 General surgery

J J GILL—10 Obstetrical surgery pathological obstetrics

M C ERICK—2 Hysterectomy ovarian cysts

I B MAGNUSON and WILLIAM A HENDRICKS—2 Plastic on hip spinal fusion

## WEST SIDE HOSPITAL

## Tuesday

C R G FORRESTER and H C LYMAN—9 Fracture clinic local anesthesia in reduction of fractures

E M BROWN—11 Surgery of gastric and duodenal ulcers

P C GEORGAN—2 Abdominal surgery management of intestinal obstruction

## Wednesday

J S NAGEL—9 Prostatectomies demonstration of functional tests in renal surgery neoplasms of the kidney

G F THOMPSON—9 Surgery of the bile tracts

S G WEST—11 Vaginal hysterectomy vaginal route in pelvic surgery

## Thursday

C R G FORRESTER and H C LYMAN—9 Results of air insufflation in treatment of sequela of cranial injuries operative treatment of recent and old bone and joint injuries

C O BYRNE—11 Gout clinic

A M HARVEY and J H CHIVERS—2 Industrial surgery

## Friday

A N CLAGGETT—9 Radium in the treatment of malignant disease demonstration of cases

C G SCHNETZER—11 Genito-urinary surgery Cystoscopies renal catheterization and X ray demonstration treatment of hydronephrosis

## ALEXIAN BROTHERS HOSPITAL

EDWARD WILLIAM WHITE EDWARD F HESS A J WOCHINSKI C O RITCH J M GLASSER and ALP J HOLM—9 daily Genito-urinary clinic

M L HARRIS A G ZIMMERMAN and DANIEL MURPHY—9 daily General surgical clinic

RALPH WHEELER L M MCNISON WILLIAM J SWIFT FRANK BAYLOR and K I STEVENS—9 daily Fracture clinic

## JOHN B MURPHY HOSPITAL

## Monday

HENRY R KENNY Surgery of bones and joints arthrodesis of the knee

WILLIAM GEHL Renal function test urological surgery

F H KAMPP Hallux valgus

## Tuesday

M J PURCELL Fracture clinic

GUSTAV BRANDLE Operative treatment of cranial injuries

A C SINDE Conservative surgery for hydronephrosis

S S McNEIL Plastic operations on hand and face

## Wednesday

ARNOLD H KEGEL Thyroid clinic operation and demonstration of cases

I V JOTANG Operative treatment of old fracture of the os calcis

JAMES LARAIN Radium treatment of carcinoma of cervix

## Thursday

WILLIAM GEHL Two stage suprapubic prostatectomy

JOSEPH CUNNINGHAM Management of the eclamptic patient

JOHN WALLNER Diagnosis and management of sterility

J WILSON GRIMES Surgical treatment of pulmonary tuberculosis

I C McDERMOTT Cesarean section

## Friday

A C GARVIA Surgical treatment of ulcers of the stomach

J M HAMILTON Surgery of the nervous system

J O POWE Tendon grafting

JAMES J MCGUIN Carcinoma of the colon and sigmoid

J E LEO Surgery of the gall bladder and common duct

## SHRINERS HOSPITAL

## Monday

B H MOORE—2 Ward visit demonstration of apparatus in use

## Tuesday

B H MOORE—9 Orthopedic operations use of ethylene anesthesia for children

MR DREHER—2 Demonstration of braces and special apparatus

## Wednesday

B H MOORE and associates—2 Demonstration of plaster technique

## Thursday

B H MOORE—9 Orthopedic operations

B H MOORE—2 Moving pictures

## Friday

B H MOORE—9 X ray demonstration of unusual conditions

B H MOORE—2 Results in orthopedic cases

## ST LUKES HOSPITAL

L L McARTHUR S W McARTHUR H E JONES C A HEDBLOW SAMUEL PLUMMER and W B FISK—9 daily General surgical clinics

LOUIS SCHMIDT and HARRY CUTLER—9 daily Genito-urinary clinics

L L RYERSON PHILIP LEWIN R O RITTER F A CHANDLER and H B THOMAS—9 daily Orthopedic clinics

ARTHUR H CURTIS and H O JONES—2 daily Gynecological clinics



## MERCY HOSPITAL

## Monday

- R. S. BERGHOFF—2 Differential diagnosis of chest diseases  
 JOSEPH LAIBE—2 Urologic surgery the relation of urology to gynecology  
 P. H. KREUSCHER—2 Congenital dislocation of the hip injection treatment of varicose veins

## Tuesday

- L. D. MOOREHEAD—9 Surgery of the thyroid gland Exophthalmic goiter toxic adenoma parenchymatous goiter and mixed type of goiter  
 J. F. GOLDEN—9 Abdominal surgery  
 F. C. JACOBSEN—9 Fractures in industrial surgery  
 J. B. O'DONOGHUE—2 Tumors of breast their surgical significance clinical significance of reverse peristalsis of the upper intestinal tract particularly in reference to gastrojejunal anastomosis reaction of different classes of thyroid cases to surgery and treatment of some unusual complications.  
 C. L. MARTIN—2 Polyps of the rectum and sigmoid tuberculous ulcers of the sigmoid and rectum

## Wednesday

- C. F. SAWYER—9 Pancreatitis—acute subacute and chronic types of intestinal obstruction  
 W. F. MCGUIRE—9 Treatment of diseases of the gall bladder and bile ducts carcinoma of the colon  
 J. E. KELLEY—9 The acute abdomen  
 HENRY SCHMITZ—2 Early diagnosis and treatment of uterine and mammary cancers Diagnosis and treatment of sterility due to blocked uterine tubes.  
 M. C. MULLEN—2 Toxemia of pregnancy

## Thursday

- P. H. KREUSCHER—9 Treatment of advanced scoliosis fractures involving the knee joint fractures of the hip  
 F. E. PIERCE—9 Fracture clinic  
 I. M. DRENNAN, L. E. GARRISON and C. F. SAWYER—2 Joint discussion on duodenal pathology with presentation of cases and the results of some experimental work consideration of esophageal stenosis by Dr Drennan.  
 M. MANDEL—2 Pernicious anemia

## Friday

- HENRY SCHMITZ—9 Gynecological surgery  
 GEORGE GRIFFIN—9 Gastro-intestinal surgery  
 J. D. CLARIDGE—9 Dislocation of internal semilunar cartilage.  
 W. S. BARNES—2 Gynecological clinic  
 W. J. PICKETT—2 Fascial suture in the repair of hernia  
 A. V. PARTIPILLO—2 Closed aseptic gastro-intestinal anastomosis  
 B. B. BEESON—2 Dermatological conditions which may become surgical

## UNITED STATES VETERANS HOSPITAL

(Edward Hines Jr Hospital Hines Ill)

## Thursday

- CARL A. HEDBLUM—9 Operations Thoracoplasty (two cases) phrenicoxeresis  
 PAUL F. BROWN—10 30 Thyroidectomy gastro-enterostomy  
 PHILIP H. KREUSCHER—1 30 Operation for chronic osteomyelitis  
 ROBERT O. RITTER—2 30 Spinal fusion  
 JOHN S. COLTIER—3 30 Demonstration in physical therapy

## UNIVERSITY HOSPITAL

## Tuesday

- ADOLPH KRAFT—9 Suppuration about the diaphragm.  
 GEORGE M. LANDAU—10 Pathological aspects of the lung from a roentgenological standpoint.  
 MAX MEYEROVITZ—11 Surgical conditions of Meckel's diverticulum

## Wednesday

- HARRY SINGER—9 Demonstration of gastro-intestinal specimens  
 KARL A. MEYER—10 Gastro-intestinal surgery

## Thursday

- ARTHUR H. CONLEY—9 Calcium and phosphorus metabolism in fractures  
 CHARLES DAVISON—10 Surgery of auto-erogenous bone transplant

## Friday

- O. H. ROHLACK—9 Surgical obstetrics  
 MARSHALL DAVISON—10 Surgery of undescended testis

## WASHINGTON PARK COMMUNITY HOSPITAL

## Tuesday

- C. C. CLARK—9 Thyroid operation carcinoma of breast  
 H. H. COX—9 Cholecystectomy hemorrhoids  
 Y. JORANSON—2 Blood transfusion spinal anesthesia.  
 F. P. HAMMOND—2 Hernia recurrent and ventral management of fracture about ankle

## Wednesday

- S. C. HOGAN—9 Gastric resection gall bladder surgery  
 L. B. BELL—9 Cholecystectomy posterior gastro-enterostomy  
 H. H. COX—2 Hysterectomy carcinoma of breast thyroid  
 C. C. CLARK—2 Hernia gastro-enterostomy

## Thursday

- F. P. HAMMOND—9 Osteomyelitis empyema.  
 Y. JORANSON—9 Goiter gastro-enterostomy  
 E. B. PERRY—10 Epididymotomy, bladder tumor  
 L. B. BELL—2 Appendectomy hemorrhoidectomy  
 S. C. HOGAN—2 Hysterectomy thyroid

## TRAUMATIC SURGERY CLINICS

(In the offices of the Medical Director of the Lumbermen's Mutual Casualty Co 4750 Sheridan Road)

## Monday

- FRED J. COTTON, Boston—2 Treatment of ununited fractures  
 J. H. SHORVELL, Boston—3 Treatment of fractures of the tibia  
 PAUL B. MAGNUSON—3 30 Fractures extent of permanent disability

## Tuesday

- DENNIS R. W. CRILE—2 Ruptured brachial plexus results of musculo-spiral nerve suture  
 WILLIAM M. HARRIS and G. V. POITTS—3 Trauma to abdomen removal of spleen carcinoma of stomach  
 L. P. KUTY—4 Report of 74 cases of trauma to abdomen with immediate operation in 27 extent of permanent disability

## Wednesday

- PHILIP H. KREUSCHER—2 Knee joint injuries  
 EDWIN W. RYERSON—3 Back injuries extent of permanent disability

## Thursday

- SIDNEY WALKER—9 30 Traumatic eye cases  
 LOYAL DAVIS—10 30 Skull fractures.  
 LEROY THOMPSON—11 30 Traumatic eye cases

## MICHAEL REESE HOSPITAL

## Tuesday

- ALFRED A. STRAUSS—9 Stomach resection for gastric and duodenal ulcer blood transfusion and resection of colon  
 GEORGE DAVENPORT—9 General surgery surgery of the central nervous system  
 IRVIN S. KOLL—9 Pyelotomy for stone nephrectomy for kidney tumor urethral plastics  
 JULIUS E. LACKNER—9 Abdominal hysterectomy interposition operation rectovaginal fistula  
 W. H. RUBOVITS—9 Obstetrical clinic demonstration of forceps version and complete suture, episiotomy

## Wednesday

- D. C. STRAUSS—9 Thyroid surgery  
 W. W. HAMBURGER—9 Masked hyperthyroidism  
 RALPH B. BETTMAN—9 Thoracoplasty phrenicotomy, internal pneumonitis  
 J. S. EISENSTADT—9 Undescended testes and prostatectomy  
 CHARLES M. JACOBS and DANIEL LEVINTHAL—9 Orthopedic surgery  
 L. F. FRANKENTHAL Sr—9 Gynecological operations

## Thursday

- EMANUEL FRIEND—9 Gall bladder surgery  
 HELLIGOR SCHILLER—9 General surgery treatment of extensive carbuncle  
 JOSEPH L. BAER—9 Complete perineal incision ovarian tumor and pelvic inflammation  
 IRVING STEIN—9 Obstetrical demonstration low cervical cesarean under local anesthesia  
 GUSTAV KOLISCHER—9 Bladder tumors  
 HARRY C. ROLNICK—9 Prostatectomy

## Friday

- ALFRED A. STRAUSS—9 Gastric resection for carcinoma and gall bladder surgery  
 HARRY JACKSON—9 Bone tumors and osteomyelitis  
 HARRY KATZ—9 Diverticulum of bladder  
 ALFRED E. JONES—9 Spinal anesthesia and prostatectomy  
 JULIUS E. LACKNER and W. H. RUBOVITS—9 Sturmdorf Wertheim operation for carcinoma of the cervix plastic repair  
 JOSEPH L. BAER and IRVING STEIN—9 Prolapse vaginal hysterectomy fibroids occiput posterior

## MOUNT SINAI HOSPITAL

## Tuesday

- V. L. SCHRAGER—9 Abdominal surgery with special reference to interpretation and management of surgical risks

## Wednesday

- I. E. BISKOW—9 Abdominal surgery  
 A. E. KANTER—9 Vaginal plastics hysterectomies

## Thursday

- V. L. SCHRAGER—9 Abdominal surgery with special reference to interpretation and management of surgical risks  
 L. HANDELMAN—9 General surgical operations.

## Friday

- J. MORA and B. A. WELLS—9 Gouters fractures  
 M. BERNSTEIN—9 Orthopedic surgery Synovectomies of knee spinal fusion

## CHICAGO MEMORIAL HOSPITAL

## Monday

- VANCE RAWSON—2 Cardiovascular disease and surgery  
 CHARLES J. DRUECK—3 Diverticulitis

## Tuesday

- ARTHUR E. MANLE—9 Management of the thyroid patient  
 PETER S. CLARK—9 Surgery of the thyroid  
 JULIA C. STRAWN—2 Surgical gynecology  
 JAMES E. FITZGERALD and M. RUTH MCGUIRE—3 30 Surgical obstetrics

## Wednesday

- BENNETT R. PARKER—9 Surgery of the gall bladder and bile tract  
 J. W. PARKER—9 Hydronephrosis and hypernephroma  
 FRANK WRIGHT and ALBERT ZRUBEK—10 Demonstration of humoral colloids relation of the colloids of the plasma to surgical problems.  
 ROBERT A. MELENDY—2 Empyema and allied conditions  
 GEORGE L. BROOKS and ROBERT A. MELENDY—4 Surgery in diabetics

## Thursday

- CHARLES E. LAHLKE—9 Surgery of the stomach and duodenum  
 PAUL M. CLIVER—2 Fractures—general management operation treatment and results  
 CHARLES J. DRUECK—3 Unusual rectal fistulas  
 M. L. WEINSTEIN—4 Gall bladder surgery under local anesthesia

## Friday

- LAURENCE L. ISEMAN—9 The cancer problem

## SOUTH SHORE HOSPITAL

## Monday

- I. REDECKER RAHE—2 General surgical clinic  
 ETHELBERG LUTTON—3 General surgical clinic

## Tuesday

- HUGH MACHECHNIE—9 General surgical clinic  
 LOUIS D. SMITH—11 Genito urinary surgery  
 MARTIN MERBIT—2 General surgical clinic

## Wednesday

- GUY VAN ALSTYNE—9 General surgical clinic  
 GEORGE G. O'BRIEN—11 General surgical clinic  
 EDMOND PROBY—2 General surgical clinic

## Thursday

- WELLES VAN HOOK—9 General surgical clinic  
 AXEL WERELIUS—10 30 General surgical clinic  
 EDWARD MASTERTON—2 General surgical clinic

## Friday

- FRANK MEAD—9 General surgical clinic  
 I. ALL ROSEBOROUGH—10 General surgical clinic  
 FRANK MURPHY—11 Fracture clinic  
 LESLIE BLACKWOOD—2 General surgical clinic

## GRANT HOSPITAL

## Tuesday

- A. G. FREY—9 General surgical clinic.  
 A. G. ZIMMERMAN—11 General surgical clinic

## Thursday

- A. G. ZIMMERMAN—11 General surgical clinic.

## Friday

- S. COOMBS—9 General surgical clinic

## ILLINOIS MASONIC HOSPITAL

Tuesday

ROBERT H HAYES HERMAN H COLE and GEORGE L DAVENPORT—9 Surgical treatment of pulmonary or chest conditions

B H HIGGINS—10 Arthritis

JOHN R HARGRE and C K TIMMONS—10 30 Surgical aspect of peptic ulcers

WILLIAM A BRAMS—11 30 Medical aspect of peptic ulcers

Wednesday

I W WHITE—9 Genito-urinary clinic

HUGH MACKECHNIE BAYARD HOLMES and JOHN F DAVIS—10 Adhesive pericarditis with establishment of collateral circulation operation demonstration of tribromo-ethyl rectal anesthesia thyroid surgery—gas troenterostomy under paravertebral block and splanchnic block

Thursday

W H GILMORE—9 X ray as an aid in pelvimetry pelvic trauma demonstration

GILBERT FITZPATRICK—9 30 Operative obstetrics estimation of the surgical risk in toxemias of pregnancy

HAROLD MILLER—10 10 Uterine displacements and their influence at puberty

SIMON KRUMHOLTZ—10 30 Trigeminal neuralgia

JOHN P SPRAGUE WALTER R FISCHER and JOHN E DAVIS—10 40 Sarcoma of humerus result of sun light and recumbent treatment of tuberculosis of the spine in a patient 47 years of age interesting orthopedic cases

Friday

W H GILMORE—9 Technique of roentgenological examination and treatment of the thymus gland in childhood

C A ALDRICH—9 15 Thymic symptom in childhood CHARLES SCHOTT—9 30 Thymus in relationship to clef palate and hair lip

MAURICE L BLATT—9 45 Thymus and its treatment.

## ST MARY OF NAZARETH HOSPITAL

Tuesday

L M CZAJA—9 30 Fracture clinic

Wednesday

R E FLANNERY—9 Traumatic surgery

T Z YELOWSKI—10 Abdominal surgery

Thursday

J WELFELD—9 Prostatic surgery

D A ORTH—10 Breast surgery

Friday

W A KULEWSKI—9 Traumatic surgery

GEORGE MUELLER—10 30 Abdominal surgery

## LUTHERAN MEMORIAL HOSPITAL

Tuesday

CHARLES F STOTZ—9 General surgical clinic.

Wednesday

ARTHUR G FREY—9 General surgical clinic

Thursday

CHARLES F STOTZ—9 General surgical clinic.

Friday

ARTHUR G FREY—9 General surgical clinic

## AUGUSTANA HOSPITAL

Tuesday

NELSON M PERCY—9 Thyroid clinic general abdominal surgery spinal anesthesia

R J ODEN—9 General surgery

Wednesday

O E NADEAU—9 General and urological surgery

J W NUZUM—9 General surgery

E H OCHSNER—9 General surgery

D W CRILE—10 Orthopedic surgery

Thursday

NELSON M PERCY—9 Thyroid clinic general abdominal surgery spinal anesthesia.

R J ODEN—9 General surgery

Friday

O E NADEAU—9 General and urological surgery

J W NUZUM—9 General surgery

E H OCHSNER—9 General surgery

D W CRILE—10 Orthopedic surgery

## ST BERNARD'S HOSPITAL

Monday

WILLIAM EPSTEIN—2 Gout clinic.

G M CUSHING—2 Gall bladder clinic

Tuesday

WILLIAM HECTOR—9 Surgical clinic

L B DONKLE—9 Surgical clinic

CHESTER GUY—2 Laboratory demonstrations.

J A PARKER—2 Surgical clinic

Wednesday

J B HAEERLEN—9 Surgical clinic

EMIL RACH—2 Obstetrical clinic

B C CUSHWAY—2 Radium cases

Thursday

J T MEYER—9 Surgical clinic

W H BOHART—9 Industrial surgery

J G FROST—2 Fracture clinic

## JACKSON PARK HOSPITAL

Tuesday

ARRIE BAMBERGER A HENNING C MacDONALD and associates—9 General surgery

S B MACLEOD—2 Traumatic surgery

Wednesday

ARRIE BAMBERGER A HENNING C MacDONALD and associates—9 General surgery

Thursday

ARRIE BAMBERGER A HENNING C MacDONALD and associates—9 General surgery

Friday

S B MACLEOD—2 Traumatic surgery

## HENRIETTA MEMORIAL HOSPITAL

Tuesday

CHANNING W BARRETT—9 Gynecological clinic

Wednesday

WILLIAM M THOMPSON—2 Management of abdominal and pelvic adhesions

## WOMEN AND CHILDREN'S HOSPITAL

## Tuesday

- ELIOUSE PARSON and KATHERINE K. TRUE—9 Lipiodol visualization of the uterine and tubal cavities  
 PEARL M STETLER—9 Watkins Wertheim operation  
 CONSTANCE O BRITIS—9 General surgical operations  
 HELEN FLYNN—2 Dry clinic Treatment of carcinoma of the uterus breast and intestines Flynn method  
 MARY E WILLIAMS—2 Dry clinic Treatment of carcinoma of the cervix and uterus with radium  
 MARGARITE H AUSTIN—2 Dry clinic Cardiograms and heart cases

## Wednesday

- MARIE ORTMAYER—9 Cystoscopic demonstrations  
 ANNA BLOUNT—9 General surgical operations  
 RACHELLE YARROS—2 Social hygiene in relation to obstetrics and gynecology  
 GRAY OTIS—2 X ray demonstration  
 JOHANNA HELMANN—2 Pediatric cases  
 CLARA OCHES—2 Twilight sleep demonstration obstetrical cases

## Thursday

- JOSEPHINE McCOLLUM—9 Demonstration of various types of anesthesia methylene nitrous oxide chloroform and ether  
 ALICE CONKLIN—9 Hernia operations  
 BERTHA BUSH—9 General surgical operations  
 BERTHA VAN HOOSEN—2 Dry clinic Hypertension in pregnancy  
 WALBURGA L KACIN—2 Twilight sleep demonstration, obstetrical cases

## Friday

- PEARL M STETLER—9 Thyroidectomy  
 JULIA STRONG—9 Gynecological operations  
 EFFIE L LOBDELL—9 Studies in sterility with demonstration of cases  
 LENA K SADLER—9 Laparotomy  
 ALICE CONKLIN—9 Hysterectomy for fibroid

## CHILDREN'S MEMORIAL HOSPITAL

## Monday

- JOHN A GRAHAM—1 The acute abdomen

## Tuesday

- JAY IRELAND—11 The treatment of empyema in children

## Wednesday

- FREDERICK B MOORHEAD—9 Cleft lip and cleft palate cartilage transplants for the correction of facial deformities

## Thursday

- ALBERT H MONTGOMERY—9 Pyloric stenosis and intussusception general surgery of children

## ST ANTHONY DE PADUA HOSPITAL

## Tuesday

- LAWRENCE RYAN FRED FIRMANN STEPHEN DONLON and JOSEPH ZABOTSKY—9 General surgical operations  
 OTTO J HIRSA—9 Genito-urinary surgery  
 I S TICHY—9 X ray demonstration

## Thursday

- JOHN SFRAPKA FRED OLLENTINE FRANK JIRKA and RALPH CUPLER—9 General surgical operations.  
 HARRY SWIJKI—9 Genito-urinary surgery  
 MAX WEISKOPF—9 Obstetrics.  
 I S TICHY—9 X ray demonstration

## RAVENSWOOD HOSPITAL

## Monday

- G W GREEN—2 Gallstone clinic  
 G N BUSSEY—2 Abdominal hysterectomy fibroids  
 G DE TARNOWSKY—2 Hemorrhagic colitis.

## Tuesday

- C A BUSWELL—9 Carcinoma of the cervix uteri  
 D B POND—9 Fracture clinic  
 R E DYER—9 Fallopian tube visualization with lipiodol  
 W F GROSSENER C C RENTFRO and F W ROHR—2 Obstetrical conference

## Wednesday

- I B WILLIAMS—9 Abdominal hysterectomy fibroids  
 P J SARMA—9 Abdominal wall incisions based on physiologic grounds.  
 F VAN NAWOWSKI—9 Hepatic abscess

## Thursday

- L WILDER—9 Goiter cases  
 F W MUELLER—9 Treatment of burns  
 W F GROSSENER C C RENTFRO and F W ROHR—2 Obstetrical conference  
 G DE TARNOWSKY—9 Ruptures of urinary bladder

## Friday

- G W GREEN—9 Surgical clinic.  
 A G SCHROEDER—9 Surgical clinic

## COLUMBUS HOSPITAL

## Monday

- FREDERICK MUELLER—2 Orthopedic surgery

## Tuesday

- M J SEIFERT and D RUPP—9 Gastric surgery  
 L GRIES—11 Postoperative use of physiotherapy  
 H C DAVIS—2 Epiphysitis

## Wednesday

- D A ORTH—9 Abdominal and breast surgery followed by talk by I F VOLLM on their medical aspects

## Thursday

- WILLIAM and LENA SADLER—9 Gynecological surgery  
 WILLIAM A SIMONICH—11 Obstetrical demonstration

## LAKE VIEW HOSPITAL

## Tuesday

- H P SAUNDERS—9 Surgery of the gall bladder demonstration of cases  
 B C CORBUS—2 Bladder tumors

## Wednesday

- ANDRE L STAPLER—2 Thyroidectomies toxic adenoma with spinal block hysterectomies fibroids with spinal anesthesia

## Thursday

- JOHN W BIRK—9 Obstetrical clinic presentation of pathological cases  
 WALTER S SIEWERTH—2 Surgical correction of pathology of female genitalia.

## Friday

- C I WYNEKOP—9 Surgery of the abdomen demonstration of cases

## FRANCES E WILLARD HOSPITAL

*Monday*

- I G DYAS Surgical treatment of ulcer of the stomach and duodenum.  
 J S NAGEL, Surgery of hydronephrosis  
 J W CARR Management of the eclamptic patient.  
 A H C. GOLDFINE Radium treatment of carcinoma of the cervix  
 GEORGE J RUKSTINAT Pathological demonstration

*Tuesday*

- VICTOR L. SCHRAGER Surgery of the abdomen  
 F A MACKOWIAK Treatment of Pott's fracture  
 H CULVER Urological surgery

*Wednesday*

- FRANK D MOORE Surgery of the gall bladder operations and demonstration of cases  
 JOHN R. HARGER Tendon grafting and suturing  
 M S COFFLER Renal function test in urological surgery  
 IUDVIG HERTZEN Pathological demonstration

*Thursday*

- A E STEWART and MILTON OCHS Operative treatment of cranial injuries  
 OTIS M. WALTER and S. BREZES Thyroid clinic  
 E S BLAINE Roentgenology

*Friday*

- J P JAROS Thyroid clinic.  
 G F THOMPSON Fracture clinic.  
 J A VALENTINE Emergency surgery

## MUNICIPAL TUBERCULOSIS SANITARIUM

*Thursday*

- CARL A. HEDBLOM—9 30 Surgery of the chest in tuberculosis operative clinic and demonstration of end results

*Friday*

- CHARLES M. McKENNA—9 30 Tuberculosis of the kidney operative clinic and demonstration of pathologic types of renal tuberculosis  
 BENJAMIN GOLDBERG and associates—2 Special measures in the general care of surgical tuberculosis

## NORTH CHICAGO HOSPITAL

(At Grant Hospital)

*Tuesday*

- FREDERICK HARVEY—9 Fracture clinic with special reference to fractures about the ankle and elbow

*Wednesday*

- CARL BECK—9 Plastic surgery of the hands and fingers

*Thursday*

- FREDERICK HARVEY—9 Thyroid clinic

*Friday*

- CARL BECK—9 Hypospadias

## POST GRADUATE HOSPITAL

*Tuesday*

- L GLASSMAN—9 Prolapse of the uterus  
 W SCHAAARE—10 Colles fracture

*Wednesday*

- LEO ZIMMERMAN—10 Vascular diseases of the extremities  
 W A N. DORLAND—2 Repair of perineum

*Thursday*

- H L MEYERS—9 Hysterectomy  
 R W HARDON—10 Injection treatment of varicose veins  
 EMIL RIES—2 Enterocoele vaginalis

*Friday*

- EMIL RIES—10 Precancerous lesions of cervix uteri.  
 M MABEE—2 Treatment of leucorrhoea.

## EVANGELICAL DEACONESS HOSPITAL

*Tuesday*

- EDWARD M. HEACOCK—9 Operative treatment of uterine fibroids

*Wednesday*

- A J SCHOENBERG—9 Carcinoma of the cervix uteri  
 F O BOWE—2 Placenta previa and management of its complications

*Thursday*

- C A BACHELLE—9 Operations for ulcer of the stomach and duodenum  
 L H FRIEDRICH—2 Management of the complications of gonorrhoea

*Friday*

- PAUL F. MORR—9 Gall bladder disease and its operative treatment.  
 J LMER W. MOSLEY—2 Caesarean section in contracted pelvis

## LUTHERAN DEACONESS HOSPITAL

*Tuesday*

- JOHN D. KOUCKY—9 General surgical clinic operation and demonstration of cases  
 LINDON SEED—9 Thyroid clinic, operations and demonstration of cases  
 GEORGE H. SCHROEDER—9 General surgical clinic operations and demonstration of cases

*Thursday*

- JOHN D. KOUCKY—9 General surgical clinic operations and demonstration of cases  
 LINDON SEED—9 Thyroid clinic operations and demonstration of cases.  
 GEORGE H. SCHROEDER—9 General surgical clinic, operations and demonstration of cases.

## SURGERY OF THE EYE, EAR, NOSE, AND THROAT

## RESEARCH AND EDUCATIONAL HOSPITAL

*Monday*

- FRANCIS L. LEDERER and OSCAR VAN ALYEA—2 Otolaryngological clinic  
JOHN J. THEOBALD—2 Functional testing of hearing

*Tuesday*

- NATHAN SCHNECK—10 Otolaryngological clinic  
SHERMAN SHAPIRO and ARTHUR J. COOMBS—2 Otolaryngological clinic  
FRANCIS L. LEDERER—2 Borderline otolaryngological operations (face plastics jaw resection mastoids and endoscopy)

*Wednesday*

- JACQUES HOLLINGER—9 30 Diseases of the labyrinth presentation of specimens methods of examination diagnosis and treatment  
I. G. SPIESMAN—10 Otolaryngological clinic  
FRANCIS L. LEDERER and JOHN J. THEOBALD—2 Otolaryngological clinic  
WALTER THEOBALD—2 Lipiodol in the diagnosis of sinus disease

*Thursday*

- JACQUES HOLLINGER—9 30 Diseases of the labyrinth presentation of specimens methods of examination diagnosis and treatment  
GEORGE S. LIVINGSTON—10 Otolaryngological clinic  
SHERMAN SHAPIRO and ARTHUR J. COOMBS—2 Otolaryngological clinic  
JOHN J. THEOBALD—2 Routine otolaryngological operations

*Friday*

- JACQUES HOLLINGER—9 30 Diseases of the labyrinth presentation of specimens methods of examination diagnosis and treatment  
J. HARNED—10 Otolaryngological clinic  
FRANCIS L. LEDERER—2 Otolaryngological clinic diagnosis and treatment of the commoner conditions

## MERCY HOSPITAL

*Monday*

- DENNIS O'CONNOR and MACOLM JOHNSON—1 Ear nose and throat clinic

*Tuesday*

- LOUIS HOFFMAN—9 Ophthalmological clinic

*Wednesday*

- ULYSSES GRIM—9 Radical antrum radical mastoid

*Thursday*

- GEORGE JORDON and CARL CHRISTOPH—9 Ear nose and throat clinic bronchoscopy and laryngoscopy

*Friday*

- GEORGE MUSGRAVE and associates—9 Ear nose and throat clinic including demonstration and X-ray illustrations of technique and use of lipiodol in ethmoidal and sphenoidal diagnosis

## CHILDREN'S MEMORIAL HOSPITAL

*Tuesday*

- MORRIS COTTLE—9 Surgical and non surgical ear diseases in infancy

## ILLINOIS EYE AND EAR INFIRMARY

*Monday*

- MAYER H. LEBENSOHN and EDWARD H. GARRAGHAN—2 Plastic surgery of eyelids  
U. J. GRIM—2 Mastoid

*Tuesday*

- HERBERT S. WALKER—2 Ocular muscles  
MICHAEL GOLDENBURG—2 Some late phases of glaucoma  
OSCAR CLEFF—2 Mastoid  
CHARLES F. YERGER—2 Radical nasal sinus operations

*Wednesday*

- DWIGHT C. ORCUTT and ROBERT H. BUCK—2 Ocular muscles and operative trachoma  
HENRY BOETTCHER—2 Tonsils and mastoids

*Thursday*

- EPHRAIM K. FINDLEY—2 Cataract operations  
EDWARD N. SCHOOLMAN—2 Bronchoscopy and plastic surgery

*Friday*

- F. R. CROSSLEY—2 Cataract operations  
ALFRED LEVY—2 Nasal sinuses and mastoid

## NORTHWESTERN UNIVERSITY MEDICAL SCHOOL

*Monday*

- L. A. SHIPPER and E. E. DILLON Chronic suppurative otitis media treated with zinc ionization  
JOHN DELPH Endoscopy

*Tuesday*

- C. F. BOOKWATER Demonstration of intranasal tear sac operation

*Wednesday*

- OTIS MACLAY Sinus work  
WILLIAM JOYCE Demonstration of plastic flap used in radical mastoid operation

*Thursday*

- CHARLES B. YOUNGER Atrophic rhinitis

*Friday*

- R. D. RUSSELL Demonstration of endolymphatic sac and valve  
ELLISON L. ROSS Vestibular reaction as affected by drugs

## RUSH MEDICAL COLLEGE

*Monday*

- WILLIAM G. REEDER—3 Ophthalmological clinic

*Tuesday*

- EARLE B. FOWLER—3 Ophthalmological clinic

*Wednesday*

- T. D. ALLEN—2 Ophthalmological clinic

*Thursday*

- WILLIAM G. REEDER—3 Ophthalmological clinic

*Friday*

- BERTHA KLEIN—3 Ophthalmological clinic

## PRESBYTERIAN HOSPITAL

## Monday

DANIEL HAYDEN—2 Ear nose and throat clinic

## Tuesday

GEORGE E SHAMBAUGH and associates—2 Otolaryngological clinic

WILLIAM H WILDER and associates—2 Ophthalmological clinic

EDWIN MCGINNIS—2 Ear nose and throat clinic

## Wednesday

GEORGE E SHAMBAUGH and associates—2 Otolaryngological clinic

WILLIAM H WILDER and associates—2 Ophthalmological clinic

## Thursday

GEORGE E SHAMBAUGH and associates—2 Otolaryngological clinic

WILLIAM H WILDER and associates—2 Ophthalmological clinic

EDWIN MCGINNIS—2 Ear nose and throat clinic

## COOK COUNTY HOSPITAL

## Tuesday

CHARLES F YFRGER—2 Ophthalmic surgery

## Wednesday

JAMES P FITZGERALD—2 Ophthalmic surgery

S SALINGER and S PEARLMAN—2 Diagnostic clinic nasal plastic surgery

## Thursday

WILLIAM J MONCREIFF—9 Surgery of glaucoma

GEORGE W BOOT—9 Bronchoscopic clinic

## Friday

THOMAS J GALLOWAY—10 Diathermy and malignancy of the mouth and throat

## POST GRADUATE HOSPITAL

## Monday

J HAYDEN—2 Accessory sinuses

## Tuesday

S SHEER—11 Benign growth of vocal cord

R CUSHMAN—2 Trephine for glaucoma

B M WOLIN—3 Septum and tonsils

## Wednesday

F STEWART—9 Glaucoma

## Friday

SAMUEL H WIENER—9 Nasal polyps and accessory sinuses

## WEST SIDE HOSPITAL

## Wednesday

W L NOBLE—9 Surgery of the eye

## Thursday

J A CLARK and A E LUND—9 Tonsillectomies

## WESLEY MEMORIAL HOSPITAL

## Monday

T P O CONNOR—2 Ear nose and throat clinic operations

## Tuesday

J GORDON WILSON—9 Otolological surgery

## ST JOSEPH'S HOSPITAL

J HOLLINGER ACSTIN A HAYDEN E W GARDNER T E BLONBERG R H HENDERSON and H A RAMSER—9 daily Tuesday to Friday inclusive Operative clinics and demonstrations in the departments of otolaryngology and ophthalmology in collaboration with WILLIAM H BERMEISTER F O FREDRICKSON BENJAMIN GOLDBERG and LELAND SHAFER of the department of internal medicine CHARLES SCHOTT GUSTAVE KAMPMEIER MAURICE BLATT and T P SALTIEL of the department of pediatrics L A HINES of the department of pathology and E W JENKINSON of the department of radiology

Pharynx and larynx—Senile tonsillectomy case histories with results sutures in the tonsil fossa for control of hemorrhage wax molds for graphically illustrating and recording conformation of nasopharynx and posterior nasal choanae direct laryngoscopy

Accessory nasal sinus disease—Incidence in adults, children and infants presentation of case histories and results, lipiodol and percussion and auscultation as a diagnostic aid

Tear sac disease—External and internal nasal operations. Nasal fractures—Diagnosis and treatment, photographs and casts for graphic records

Ear—Demonstration of audiometers (by courtesy of Graybar Electric Co) for group and individual hearing tests indications for operation in acute mastoiditis, case histories Pohlmann's stapedius muscle exercise and results.

J HOLLINGER—12 daily Demonstration of microscopic and macroscopic temporal bone specimens

Moving pictures lantern slides and chalk talks will be used to illustrate certain features of the above program

## ILLINOIS CENTRAL HOSPITAL

## Tuesday

J H McLAUGHLIN—9 Ear nose and throat clinic

H J SMITH—9 Emergency surgery of the eye industrial injuries

## Wednesday

J H McLAUGHLIN—9 Ear nose and throat operations.

H J SMITH—9 Emergency surgery of the eye industrial injuries

## Thursday

J H McLAUGHLIN—9 Ear nose and throat clinic.

H J SMITH—9 Emergency surgery of the eye industrial injuries

## Friday

J H McLAUGHLIN—9 Ear nose and throat operations.

H J SMITH—9 Emergency surgery of the eye industrial injuries

## CHICAGO MEMORIAL HOSPITAL

## Monday

RICHARD H STREET—4 Tonsillectomies under local and general anesthesia

## Tuesday

ALFRED E LEWY and RICHARD W WATKINS—3 Mastoids.

IRVING I MISKAT—4 Plastic surgery

## COLUMBUS HOSPITAL

## Wednesday

C O LINDSTROM—11 Mastoiditis and various types of tonsillectomies

M GOLDENBERG—2 Ophthalmic surgery

## Thursday

L R MELLIN—2 Plastics on nose

## EYE, EAR, NOSE, AND THROAT HOSPITAL

Monday

- P. A. GRAVES—2 Newer refraction methods for myopia, demonstration of cases  
 T. S. KAMMERLING—2 Eye clinic  
 H. B. FULLER—2 Ear, nose and throat clinic  
 IGNAZ SOMMER—4 30 Intracranial relation to ear, nose and throat

Tuesday

- H. B. FULLER and D. C. BROWN—9 Ear, nose and throat surgical clinic  
 O. B. NUGENT—11 Surgical treatment of chronic dacryocystitis  
 W. A. FISHER—2 Simplified Barraquer operation for cataract extraction  
 R. CASTROVIEJO—4 Demonstration of various methods of ophthalmoscopy (simplified Gullstrand, giant Gullstrand, red free light, direct and indirect)

Wednesday

- T. S. KAMMERLING and L. SAVITT—9 Ear, nose and throat surgical clinic  
 JOSEPH BECK—9 Surgical treatment of carcinoma of the larynx  
 O. B. NUGENT—11 Photography as applied to the practice of ophthalmology. Demonstration of making of photographic records in ocular diseases, in plastic surgery. Anterior stereoscopic camera, fundus photography, making of lantern slides, photomicroscopy. Motion pictures  
 T. S. KAMMERLING—2 Eye clinic  
 H. B. FULLER—2 Ear, nose and throat clinic  
 IGNAZ SOMMER—4 30 Tuning forks

Thursday

- O. B. NUGENT—9 Cataract clinic. Cataract extraction by simplified Barraquer method, teaching of cataract extraction by motion pictures  
 R. CASTROVIEJO—11 Practical demonstration of slit lamp microscopy  
 H. B. FULLER—2 Eye clinic  
 T. S. KAMMERLING—2 Ear, nose and throat clinic  
 IGNAZ SOMMER, R. CASTROVIEJO and E. GALLARDO—2 Demonstration of various laboratory methods and the practical application of clinical findings  
 R. CASTROVIEJO—4 30 Histopathology

Friday

- H. B. FULLER, T. S. KAMMERLING and O. M. STEFFENSON—9 Ear, nose and throat surgical clinic  
 JOSEPH BECK—9 Pathology of the ear, nose and throat  
 H. W. WOODRUFF—11 Deep incision for glaucoma, tucking operation for strabismus  
 T. S. KAMMERLING—2 Eye clinic  
 H. B. FULLER—2 Ear, nose and throat clinic  
 IGNAZ SOMMER—4 30 The rôle of the nasal accessory sinuses in nasal diseases

## ILLINOIS MASONIC HOSPITAL

Friday

- ALVA SOWERS—10 20 Cataract operation with discussion relative to older and newer methods  
 W. R. BOYNTON—10 40 Strabismus, scientific exactness in differential diagnosis and operative treatment of strabismus, exhibit of instruments, demonstration of cases  
 MAURICE H. COTTELL—11 Laryngeal paralysis, ventriculocordectomy  
 T. J. WILLIAMS—11 20 Otolaryngological clinic  
 H. F. TAYLOR—12 20 Tonsillectomies

## MICHAEL REESE HOSPITAL

Monday

- M. L. FOLK—2 Diagnosis and treatment of iritis

Tuesday

- SAUEL J. MYER—2 Operations for glaucoma

Wednesday

- ROBERT VON DER HEYDT—2 Slit lamp microscopy of the living eye

Thursday

- S. C. CRENNWALD—2 Operations for strabismus

Friday

- ROBERT VON DER HEYDT—2 Photography of the anterior segment of the eye

## WOMEN AND CHILDREN'S HOSPITAL

Tuesday

- GERTRUDE THOMSON—9 Tonsillectomies, Beck method

Wednesday

- LILLIAN TAYLOR—9 Tonsillectomies, Sluder method  
 GEORGIANA D. THEOBALD—9 Cataract operation  
 BEULAH CUSHMANN—9 Operation on eye  
 IONE I. BEEM—9 Operation for strabismus

Thursday

- ALICE K. HALL—9 Tonsillectomies under local anesthesia, dissection method

## MOUNT SINAI HOSPITAL

Wednesday

- NOAH SCHOOLMAN, JACOB LIRSCHUTZ and associates—9 Bronchoscopies and lipiodol injections in pulmonary conditions, asphyxiography  
 NOAH SCHOOLMAN, JACOB LIRSCHUTZ and associates—2 Lipiodol studies and operations on accessory sinuses, X-ray studies and operations for ear conditions

## LAKE VIEW HOSPITAL

Monday

- FRANK J. NOVAK, JR.—2 Suspension laryngoscopy

Wednesday

- ROBERT H. BUCK—9 Demonstration of various eye operations

## EVANGELICAL DIACONESS HOSPITAL

Monday

- ARTHUR GELDER—2 Deflections of the nasal septum

Tuesday

- G. THOMSEN VON COLDITZ—2 Types of tonsil operations

## CARFIELD PARK HOSPITAL

Tuesday

- L. B. PHELPS—9 Indications for operative treatment in acute mastoiditis

## GRANT HOSPITAL

Tuesday

- O. KRAFT—9 Eye clinic

## RAVENSWOOD HOSPITAL

Friday

- A. N. MURRAY and W. J. NOONAN—2 Otolaryngological clinic



## WASHINGTON BOULEVARD HOSPITAL

*Tuesday*

LINA F MCBRIDE—2 Nose and throat clinic

*Wednesday*

CASSIUS and VIRGIL WESTCOTT—2 Eye clinic

*Thursday*

JINNY F MCBRIDE—2 Nose and throat clinic

## ST LUKAS HOSPITAL

*Tuesday*

JOHN A CAVANAUGH and EDWARD P NORCROSS Nose and throat clinics

*Friday*

JOHN A CAVANAUGH and EDWARD P NORCROSS Nose and throat clinics

## NORTH CHICAGO HOSPITAL

(At Grant Hospital)

*Tuesday*

HARRY L POLLOCK—9 Surgical treatment of acute mastoiditis

*Thursday*

HARRY L POLLOCK—9 Intranasal surgery

## MUNICIPAL TUBERCULOSIS SANITARIUM

*Thursday*

FRANCIS LEDERER—2 Tuberculosis of the larynx and bronchoscopic demonstrations

## JOHN B MURPHY HOSPITAL

*Monday*

G W MAHONEY Emergency surgery of the eye and ocular injuries

*Tuesday*

EDWARD GARRAGHAN Operations for acute glaucoma

*Wednesday*

S SCIARRETTA Indications for operative treatment in acute mastoiditis

## FRANCES E WILLARD HOSPITAL

*Monday*

W D BRODE and C T CARR Nose and throat clinic

*Tuesday*

FRANK J NOVAK Acute mastoiditis

## ALBERT MERRITT BILLINGS HOSPITAL

*Monday*

D KATZ—2 Eye clinic

*Thursday*

LOUIS BOTTMAN—9 Eye clinic

## ST MARY OF NAZARETH HOSPITAL

*Tuesday*

G MAHONEY and E RULING—9 Eye clinic

*Friday*

J J KILLEEN—10 Septum surgery

## TWELFTH ANNUAL HOSPITAL STANDARDIZATION CONFERENCE

Monday 9:30—Grand Ballroom Stevens Hotel

FRANKLIN H. MARTIN, M.D., Chicago, presiding  
Address of Welcome ARNOLD H. KEGEL, M.D., Chicago  
Commissioner of Health  
Introduction of distinguished guests and representatives  
of national organizations Surgeon General MERRITT  
W. IRELAND, Washington President Elect American  
College of Surgeons

Symposium on Medical and Surgical Economics

Introductory Remarks FRANKLIN H. MARTIN, M.D.  
Chicago

Medical and Surgical Economics from the Standpoint of  
the Hospital Administrator C. G. PARNALL, M.D.  
Rochester, N. Y. Medical Director Rochester General  
Hospital President American Hospital Association  
The Relationship of Medicine and Its Aids to the Cost of  
Medical Care REV. ALPHONSE M. SCHWITALLA,  
S. J., Ph.D., St. Louis Dean St. Louis University  
School of Medicine President Catholic Hospital  
Association

Comments on Nursing and Hospital Costs for Individuals  
in Moderate Circumstances WILLIAM J. MAYO, M.D.  
Rochester, Minn.

Comparison of Medical and Hospital Costs for Individuals  
in Moderate Circumstances STEWART H. ROBERTS,  
M.D., Atlanta Member Committee on the Cost of  
Medical Care

General summary with special reference to the influence  
of University Diagnostic Clinics and their bearing on  
the fees of independent practitioners L. H. HARDY,  
R. SMITH, M.D., Grand Rapids Chairman Committee  
of the Michigan State Medical Society to Survey and  
Study the Problem of Hospital Charity in Michigan  
Hospitals

Presentation of Official Report of Hospital Standardization  
and List of Approved Hospitals for 1929 Twelve  
Years in Retrospect MALCOLM T. MACLEACH,  
M.D., Chicago Associate Director American College  
of Surgeons Director of Hospital Activities

Monday 10:00—Grand Ballroom Stevens Hotel

W. W. TEARSON, M.D., Des Moines presiding  
Open Forum—Nursing Conducted by ASA S. BARON,  
Chicago Superintendent Presbyterian Hospital  
The Superintendent's Viewpoint of the Nursing Problem  
PAUL H. FESLER, Minneapolis Superintendent Uni-  
versity Hospitals

How Can We Be Efficient Nursing Care of the Patient?  
F. MURILL MCKEE, Brantford, Ontario Super-  
intendent Brantford General Hospital and ST. TER  
HELEN JARFELL, Chicago Superintendent of Nurses  
St. Bernard's Hospital

Discussion opened by ADOLPH ELDREDGE, R. N., Madison  
Director Bureau of Nursing Education State of  
Wisconsin

Staff Conferences WALTER S. GOODALE, M.D., Buffalo  
Superintendent Buffalo City Hospital

Discussion opened by JOHN T. BURRIS, M.D., High Point,  
N. C., Surgeon High Point Hospital

Demonstration—Model Staff Conference by the Staff of  
Hawthornood Hospital Chicago

Tuesday 9:30—North Ballroom Stevens Hotel

JOSEPH C. DANE, M.D., Philadelphia presiding

The Accrediting of Surgical Deaths ERNEST LEROI HUNT,  
M.D., Worcester, Mass. Surgeon and Director of  
Surgical Services Worcester City Hospital

Discussion opened by JOHN DEJ. PEMBERTON, M.D.,  
Rochester, Minn. Assistant Professor of Surgery  
Mayo Foundation University of Minnesota Medical  
School

Symposium The Control and Elimination of Infections  
in Hospitals

Hernia Operations as an Index of Hospital Infections  
CHARLES N. COMBS, M.D., Terre Haute, Ind.  
Superintendent Union Hospital

Discussion opened by SOUTHGATE LEIGH, M.D., Norfolk,  
Va. Visiting Surgeon and Gynecologist Sarah Leigh  
Hospital and Clinic

How Can We Determine the Efficiency of the Surgical  
Mask? IRVING J. WALKER, M.D., Boston Clinical  
Professor of Surgery Medical School of Harvard  
University

How Can We Assure the Sterility of Catgut? FRANK L.  
MELNEVEY, M.D., New York, Department of Surgery  
Columbia University

Discussion opened by SUMNER L. KOCH, M.D., Chicago  
Assistant Professor of Surgery Northwestern Uni-  
versity Medical School

Plumbing in Hospitals as a Source of Infection and Pro-  
posed Safeguards ARNOLD H. KEGEL, M.D., Chicago  
Commissioner of Health

Organizing for Emergencies, CHARLES F. NEERGAARD,  
New York Trustee Carson C. Peck Memorial Hos-  
pital Brooklyn

Tuesday 2:00—North Ballroom Stevens Hotel

WALTER H. CONLEY, M.D., New York presiding

The Health Inventorium in the Standardized Hospital  
FRANKLIN H. MARTIN, M.D., Chicago

Open Forum—Administrative Problems Relating to the  
Care of the Patient Conducted by ROBERT JOLLY,  
Houston Superintendent Baptist Hospital Trustee  
American Protestant Hospital Association

What Should Be the Hospital Trustee's Responsibility for  
the Care of the Patient? How Can the Hospital  
Trustee know when the Patient is Receiving Efficient  
Hospital and Medical Service? LOUIS J. MCKENNEY,  
Highland Park, Mich. Chairman Board of Trustees  
Highland Park General Hospital

Discussion opened by JOHN D. SPELMAN, M.D., Pitts-  
burgh Superintendent Montefiore Hospital

What Factors enter into an Efficient Operating Room  
Service? A. C. GALBRAITH, Toronto, Superintendent,  
Toronto Western Hospital

Discussion opened by MAJOR G. SEELIG, M.D., St. Louis  
Professor of Clinical Surgery Washington University  
School of Medicine

The X-Ray Department in Hospital Management JOHN  
F. DALGHERTY, M.D., Brooklyn Superintendent  
Jewish Hospital

Discussion opened by EDWARD S. BLATNEY, M.D., Chicago  
Radiologist Wesley Memorial Hospital Director  
National Pathological Laboratories

What Is Being Done to Assist the Person of Moderate  
Means in Securing Adequate and Efficient Hospital  
and Medical Service? MICHAEL DAVIS, Ph.D., Chicago  
Julius Rosenwald Fund

Discussion opened by HERMAN I. FRITSCHEL, Milwaukee  
Superintendent Milwaukee Hospital

*Wednesday 9:30—North Ballroom Stevens Hotel*

R C BUTLER M D Madison presiding. Joint Session with the Association of Record Librarians of North America

**Symposium—Increasing the Efficiency of Case Records**

The Role of the Record Librarian in Maintaining an Efficient Record System in a Hospital FLORENCE G BANCROCK Ann Arbor Record Librarian University of Michigan Hospital

Discussion opened by C W MINGER M D Valhalla Superintendent Grasslands Hospital

Maintaining Efficient Case Records in an Open Hospital MAJORIE BOLLTON St Louis Record Librarian Jewish Hospital

Discussion opened by DONALD C SMELTER M D St Paul Superintendent Charles T Miller Hospital

The Value of Accurate Records for the Study of Cancer MALCOLM SLYE Ph D Chicago Associate Professor of Pathology University of Chicago

Discussion opened by BOWMAN C CROWELL M D Chicago Associate Director and Director of Clinical Research American College of Surgeons

The Correlation of the Record Department and Medical Library in the Hospital STELLA F WALKER Chicago Director Literary Research Department American College of Surgeons

Discussion opened by MARGUERITE SIMMONS Chicago Medical Librarian Ravenswood Hospital and MAURINE WILSON Chicago Record Librarian Ravenswood Hospital

The Nurse's Contribution to the Medical Record T R POTTON M D Chicago Superintendent Illinois Masonic Hospital

Discussion opened by LAURA I LOGAN RN Chicago Dean Illinois Training School for Nurses

General Discussion opened by EDITH M ROBBINS Boston Chief Record Librarian Peter Bent Brigham Hospital and A I LOCKWOOD M D Toronto Surgeon Lockwood Clinic

*Wednesday 2:00—North Ballroom Stevens Hotel*

Standardization of Surgical Dressings and Materials—Final Report FREDERIC H SLAYTON M D Chicago Director Hospital Research and Information Department American College of Surgeons

Discussion opened by HUGH SCOTT M D Hines Ill Medical Officer in Charge U S Veterans Hospital

Open Forum—Professional Problems Affecting the Care of the Patient Conducted by LEWIS A SEYDOW M D Hartford Superintendent Hartford Hospital President Elect American Hospital Association

The Value and Importance of the Hospital Out Patient Department IRVING S CUTLER M D Chicago Dean Northwestern University Medical School Superintendent Passavant Memorial Hospital

What Constitutes an Efficient Clinical Laboratory Service for a Hospital? FRANK W HARTMAN M D Detroit Pathologist Henry Ford Hospital

Discussion opened by OLIVER W LOHR M D Saginaw Mich, Director Central Laboratory of Saginaw

What Constitutes an Efficient Anesthesia Service for a Hospital? WESLEY BOURNE, M D C M MSc, Montreal

Discussion opened by JOHN LUNDY M D Rochester Director Department of Anesthesia Mayo Clinic and ISABELLA HERB M D Chicago Chief Anesthetic Presbyterian Hospital

A Plan for Increasing the Number of Autopsies MATTHEW DUBIN Philadelphia Superintendent Mount Sinai Hospital

Discussion opened by FRANK J NOVAK JR M D Chicago Otolaryngologist Lakeview Hospital

The Need for Consultations in the Care of the Seriously Ill GEORGE W SWIFT M D Seattle Brain Surgeon Children's Orthopedic and King County Hospitals

Discussion opened by FRANK H LAHEY Boston Surgeon New England Deaconess and New England Baptist Hospitals

*Thursday 9:30—North Ballroom Stevens Hotel*

Open Forum conducted by MALCOLM T MACKACHERN M D Chicago Director of Hospital Activities American College of Surgeons assisted by ROBERT JOLLY Houston Superintendent Baptist Hospital

The entire session will be devoted to discussion of questions and problems presented from the floor and not discussed in previous sessions

*Thursday 2:00—5:00*

Demonstrations in hospital planning construction, equipment administration and procedures in Chicago hospitals

# SURGERY, GYNECOLOGY AND OBSTETRICS

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## THE VALUE OF RADIOLOGY IN THE DIAGNOSIS OF PERFORATED PEPTIC ULCER<sup>1</sup>

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Attending Surgeon, Cook County Hospital

AND

HARRY A. SINGER, M.D., CHICAGO

Attending Physician, Cook County Hospital

THE potential value of the X ray as an aid in the diagnosis of perforated peptic ulcer was first suggested in August of 1915 by Popper in a paper dealing with radiological observations in cases of gastrointestinal perforation. Four years before the appearance of this paper Popper observed a patient with symptoms interpreted clinically as those of an acute perforative peritonitis with spontaneous recovery. X ray examination with a barium meal undertaken 8 days after the onset of the abdominal pain showed pyloric deformity and stenosis with hepatoluxation. Between the right diaphragm and the upper surface of the liver there was noted during fluoroscopy a sickle shaped zone of radiolucence which was interpreted as air escaped through a perforated peptic ulcer. Popper noted that such a spontaneous pneumoperitoneum can hardly be confounded with any other condition that its presence or absence can be established with relative ease and that it occurs following perforation of gastric duodenal and intestinal ulcers and also occasionally in perforative appendicitis and after injuries to the intestines.

Earlier in the same year (April 1915) Wieland observed a case of perforated ulcer with a crescentic transparent zone between

the liver and the right cupola of the diaphragm. This radiolucent zone disappeared when the patient was changed from the up right to the recumbent position. At laparotomy undertaken some time later a duodenal ulcer was found agglutinated firmly to the pancreas. There was also periduodenitis with abscess formation and interposition of a portion of the transverse colon between the upper surface of the liver and the right leaf of the diaphragm. A subsequent necropsy confirmed these observations. Wieland concluded that the duodenal ulcer led to perforative peritonitis with agglutination and fixation of the proximal segment of the transverse colon in the right subphrenic space. In consequence of this autopsy observation the air seen on fluoroscopy was interpreted not as lying free in the peritoneum but in the colon, with also a downward displacement of the liver similar to the hepatoptosis described earlier by Chlaiditi. In 1916 Lenk a military surgeon reporting on the X ray observations of abdominal gunshot wounds, emphasized the significance of intraperitoneal free air in these conditions. He suggested that in civil practice radiological examination for pneumoperitoneum would be of value in differentiating a perforated peptic ulcer from a ruptured appendix or gall bladder.

<sup>1</sup>From the Department of Surgery, Cook County Hospital, Chicago, and the Department of Medicine, University of Illinois, Chicago. Received for publication April 5, 1929.

In recent years the literature dealing with the diagnosis of perforated peptic ulcer has become enormous yet relatively few reports on spontaneous pneumoperitoneum as an early<sup>1</sup> diagnostic aid in perforated peptic ulcer have been published. Single cases are reported by Weil (1916), Martin (1917), Bager, Estes (1920), Kellogg (1921), Dahm (1922), Wessler and Jaches (1923), MacCharles (1925), Ayerza et al (1927), and Friend (1928). The number of series of cases reported is likewise limited. Schottmueller in 1921 described 3 cases of acute perforated ulcer in 2 of which free peritoneal air was demonstrated. In the third the author, in order to explain the absence of a pneumoperitoneum, assumed rupture to have occurred into the omental bursa. At the annual meeting of the Missouri Valley Medical Association, June, 1922, Vaughan read a paper on "The Value of Radiology in Acute Surgical Abdomen" in which he cited and demonstrated X ray films in a few cases of perforated peptic ulcer with spontaneous pneumoperitoneum. Five cases were reported by Copher in 1924, in one of which the cause of the perforative peritonitis was not established. In the same year Vaughan and Brams (24) published data on 15 cases of anatomically proved perforated ulcer in 13 of which free air was present. In 1925, Guillemin recorded 7 cases of spontaneous pneumoperitoneum 4 of which were due to perforated ulcer. Vaughan and Brams (25) in a second report which was published also in 1925 added 14 more observations to their previous cases raising the number to 29. In a paper which appeared in 1927 Cottle and Spaulding discussed the value of the X ray based upon a study of four cases in which perforation occurred aboard ship. In 1928, Uthi and Pasquier each described two cases. The following review includes 29 previously reported and 43 additional cases making a total of 72 patients with perforated ulcer examined radiologically primarily for the presence of intraperitoneal free air.

Our first resort to the X ray as an aid in the diagnosis of acute perforation of the stomach or duodenum occurred as follows:

A man 56 years of age while being examined by one of us (HVS) on November 22 1921 developed sudden symptoms of perforative peritonitis. The history of antecedent ulcer distress typical in all respects had already been obtained and the diagnosis of a perforated peptic ulcer seemed highly probable. A surgeon (RTV) was called. A non reducible tender epigastric epiplocele led to a discussion at the bedside regarding the possibility of a strangulated linea alba hernia as the cause of the patient's symptoms. When asked to sign the formal operative permit the patient, who had listened to the discussion demanded further proof of the correctness of the diagnosis before submitting himself to a laparotomy. It occurred to one of us (RTV) to look with the fluoroscope for the presence of a pneumoperitoneum. A large freely movable peritoneal gas bubble was demonstrated. The patient's consent to operation finally obtained and the ulcer perforation found and sutured.

Throughout the course of our work with abdominal emergencies we have been continually more impressed as to the value of this method as an aid in diagnosis and feel that its limited use by surgeons up to the present time is due mainly, if not entirely, to lack of knowledge of its worth. All those surgeons and others who have actually used the X ray for this purpose recommend it highly. The objections which various clinicians have offered to this method of examination of the "acute abdomen" indicate a lack of acquaintance with radiology or a limited experience with acute abdominal conditions, or both. For instance it has been alleged that X ray examination adds unnecessary manipulation. That is not the case with our X ray technique which has been described elsewhere (see Vaughan and Brams 24 25). We repeat that usually the patient is merely passed before the upright fluoroscope while lying on the hospital cart en route to the operating room. Diagnostic consultations are frequently held in the X ray department instead of in the ward or operating room. Usually we observe the patient fluoroscopically in the left lateral as well as in the supine position. Fluid levels and demilunes of peritoneal exudate if present, gas patterns in the bowel and diaphragm movements are also noted. The left lateral position is favored since it permits the gastric air bubble to occupy the juxtapyloric area in which over 90 per cent of free ulcer perforations occur, and the left lateral

<sup>1</sup>Reports dealing with the gas content of the subphrenic abscess which occurs later as a complication are not included. The so-called "bubbling" of the peritoneum which was demonstrated radiologically as a back as 1901 (see Weinberg 1).

position also tends to prevent further leakage of gastric liquid contents while air is permitted to escape instead. The amount of manipulation required is trifling compared with the manipulation involved in physical examination by the careful surgeon, who may require several changes of position including the sitting posture in order to enable him to percuss, palpate, and auscultate the patient's chest and abdomen. This complete physical examination is essential to the accurate diagnosis of acute abdominal conditions and we never omit it. X ray examination is equally essential.

Another objection occasionally interposed is that valuable time is consumed in the X ray examination. This objection is not valid in good modern hospitals which possess average X ray equipment. Five minutes is more than sufficient for a complete fluoroscopic examination, less time than it requires to do a white blood count. Nor need the X ray examination cause even a moment's delay when "acute surgical abdomen" already has been diagnosed, for fluoroscopy is then performed while the operating room is being "set up." The taking and developing of films is unnecessary for diagnosis since fluoroscopy gives all the needed information, however films are useful for purposes of record when sufficient time is available. Delays of deliberation and consultation on the other hand cost not minutes but hours when the X ray might give an immediate decision. A colleague, who "feels that the X ray is not practical," requested in a case of perforated ulcer an hourly blood count in order to determine the presence or absence of a perforative peritonitis. The fluoroscope settled the problem at a glance.

Some surgeons and internists offer no objection to radiographic examination but state that they "do not need it" for diagnosis. These are clinicians who have seen only a case or two or have merely a textbook knowledge of perforated ulcer. It is in fact, as impossible to make a correct diagnosis in every case of a long series of cases of perforated peptic ulcer as it is in a long series of cases of acute appendicitis. No clinician of the present day is able to make an invariably correct diagnosis in all cases of acute abdominal conditions

previous to laparotomy. The most competent surgical opinion for many years has been that exploratory laparotomy is necessary to complete the diagnosis in a substantial proportion of these cases. The correctness of that dictum still holds and perforated peptic ulcer is no exception. All clinical data available, including the X ray are sometimes insufficient to complete the diagnosis in atypical cases. For instance, even Moynihan in 49 cases which turned out to be perforated peptic ulcer made a right lower quadrant appendiceal incision in 18 cases, and Moynihan generally and rightly is considered an abdominal diagnostician of first rank. W. J. Mayo writes: "In nearly all of our earliest operations for acute perforations of the duodenum a negative exploration of the appendix was first made and the perforation of the duodenum was found during further exploration." It is by no means unheard of for a surgeon to diagnose appendicitis and remove the appendix in such a case and discover the ruptured ulcer subsequently at autopsy. We know a few instances in which this has happened to university professors of surgery. It follows therefore, that their students as well as they themselves cannot afford to dispense with any possible clinical adjuvant in the diagnosis of perforated ulcer or in other cases of "acute surgical abdomen." The last of these statements will be denied only by those surgeons who are beginning their experience with acute abdominal conditions or who do not have routine autopsy checks in their fatal cases.

In our present series 72 cases with a final diagnosis of perforated peptic ulcer were examined with the X ray shortly after admission. Nine patients in whom free intra peritoneal gas was absent recovered spontaneously without operation. Omitting these 9 because definite proof of a perforated ulcer is lacking there remain 63. In 54 of these 63 cases evidence of a pneumoperitoneum was found. In 49 of the patients with free intra peritoneal gas, the presence of a perforated peptic ulcer was proved by operation or autopsy. The other 5 patients recovered spontaneously without operation, but subsequent clinical and X ray examinations demonstrated the presence of peptic ulcer in all 5.



the patient would consent may have a leaking ulcer, we adopt the following procedure. The patient is left on the hospital cart or put back to bed to lie on his left side for one or more hours in order to allow the air within the stomach to rise to the pyloric region and duodenum (where over 90 per cent of the free perforations are located) and escape if it will. The patient is examined physically and radiologically at intervals. If air is present in the stomach and the perforation is still patent and not walled off soon a few bubbles of air will leak out and appear at the uppermost point of the peritoneal cavity, i.e. between the liver and the right abdominal wall, when the patient is lying on his left side. When pneumoperitoneum is absent we often sit up the patient to examine the heart, lungs, mediastinum and diaphragm. We have no fear of sitting up a patient momentarily who has perforative peritonitis whenever anything of value is likely to be derived from either physical or radiological examination in this position. Perforative peritonitis is diffuse in any event and the pelvic peritoneum with stands infection better than any of the upper abdominal portions. Any free fluid found at operation in the abdomen, flanks or in the pelvis is removed by suction because the peritoneum recovers more easily and promptly when dry.

*Why free gas is not present in some perforations.* The postural procedure described above, viz. placing the patient on the left side is based upon the natural presumption that air if present in the stomach must be brought in contact with the perforation in order to escape through it into the peritoneal cavity. Accordingly if a patient with a perforated ulcer assumes and maintains the right lateral position which is the least favorable for the escape of air, little or no gas will find its way into the peritoneal cavity. A less frequent reason for the failure of free air to accumulate in the peritoneal cavity following perforation is the absence of gas in the stomach at the time of rupture. In this event simultaneous absence of air in the peritoneum does not possess the same negative diagnostic value as when the usual gastric air bubble is present. A third and perhaps the most frequent cause for the



Fig. 2 Same case as Figure 1. Left lateral position.

failure of pneumoperitoneum to develop is that the perforation is so tiny or becomes stopped up so quickly that too little air leaks out to be visualized or none leaks out at all. A fourth possibility to account for the absence of a shifting peritoneal air bubble is demonstrated by two of our cases in each of which at laparotomy the gas was found closely circumscribed by perigastric adhesions. The encysted gas was evacuated at operation in both cases.

*Spontaneous pneumoperitoneum from other causes.* It should be borne in mind, as pointed out by Popper in his original article on the subject that spontaneous pneumoperitoneum occurs in conditions other than perforated peptic ulcer. Free intraperitoneal air was found radiologically by Kenez, following acute perforation of a tuberculous ulcer of the appendix. Two cases of suppurative and perforative appendicitis producing pneumoperitoneum were reported by Guillemin. Dandy recorded a case of typhoid perforation which was recognized with the aid of the X-ray. Bager described a case in which a carcinoma of the stomach was resected and due to a leak in the suture line a pneumoperitoneum resulted. Pneumoperitoneum following gunshot wounds was described by Lenk in military service and by Guillemin in civil practice. A unique case of artificial pneumoperitoneum was cited by Dunham in which a metal catheter, used for the purpose of inducing



abortion, penetrated the peritoneal cavity and permitted air to enter

During the course of our study of acute abdominal conditions, we have discovered several cases of pneumoperitoneum following blunt trauma to the abdominal wall as well as gunshot and stab wounds. Aside from these traumatic cases we have encountered 9 instances of spontaneous pneumoperitoneum not due to peptic ulcers. In 2 cases the gas was caused by perforated carcinoma of the stomach, in 3 by perforative appendicitis, in 2 by perforation of a tuberculous ulcer of the small intestine, and in 2 by rupture of a typhoid ulcer. Fortunately, the history and the associated clinical data rendered the diagnosis clear in all but 2 cases, viz., a perforated gastric carcinoma and a ruptured appendix.

The fact that spontaneous pneumoperitoneum is found in abdominal conditions other than perforated peptic ulcer constitutes no practical objection to its diagnostic value. Almost without exception every acute abdominal condition with a "free gas bubble" is a case of perforative peritonitis from rupture of a gas-containing viscus. Unless the peritonitis is relatively trifling in degree and extent, surgical exploration is required in any event. The most serious error which may occur under these circumstances is the possible choice of an unfavorable site for the laparotomy incision. We are inclined to believe, however, that if X-ray examination is properly used to supplement the usual history and clinical examination, few mistakes in the placing of incisions will occur in cases of perforated peptic ulcer.

#### SUMMARY

Seventy-two patients diagnosed perforated ulcer were examined radiologically for pneumoperitoneum at the time of admission to the hospital. In 63 of the 72 patients the diagnosis of a perforated ulcer was definitely established. Of these 63, 54 or 85.7 per cent had free intraperitoneal air as determined fluoroscopically. In the 9 remaining patients the evidence of perforated ulcer was not conclusive inasmuch as pneumoperitoneum was absent, laparotomy was not performed, and autopsy was precluded by recovery.

The clinical picture in the 9 unproved cases corresponds to that seen in perforations which become spontaneously sealed following the escape of a limited amount of gastric or duodenal content. The reason for the lesser frequency of pneumoperitoneum in these *formes frustes* cases is probably the same which explains the mildness of the course, viz., a small leak and a trifling leakage.

During the period in which these perforated ulcer cases were observed, spontaneous pneumoperitoneum due to other causes (exclusive of trauma) was encountered nine times. In all but 2 of the 9 cases the correct diagnosis as to the cause of perforation was rendered clear by the history and clinical observations.

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## DISLOCATION OF THE TESTIS

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**A**n ectopic testis is by no means a rare occurrence, in truth, it is rather common. Cryptorchidism (abdominal, suprainguinal, inguinal, and subinguinal) has been found to occur in from 0.1 to 0.2 per cent of all young adults. In the vast majority of cases it is a congenital condition due to defective development, either an abnormal mesorchium, a vicious insertion of the gubernaculum testis, a narrowness of the external inguinal rings, a shortness of the cord or vas and adhesions binding these structures, or a rudimentary development of the scrotum. On the other hand, aberrant migration of the testis is rather uncommon and is far rarer than a simple cryptorchidism. Many cases are reported in which the testis before or immediately after birth has migrated to various regions out of its normal course of descent. These represent the various types of congenital ectopic testis: pelvic, femoral, crural, penile, pubic and perineal. With the exception of the congenital perineal testis, these varieties are not common. Of the perineal type, however, Weinberger has collected 74 and Klein 81 cases. There is one other congenital anomaly of the descended testis of which there are 13 cases reported in the literature, the so-called transverse ectopic testis. In this abnormality the testis comes out of one external inguinal ring and then crosses to lie in the scrotum on the opposite side. These various congenital anatomical anomalies of cryptorchidism and aberrant migration of the testis are all present at the time of or occur shortly after birth.

In this paper we are not primarily concerned with the congenital ectopic testis but rather with traumatic dislocation of the normally descended testis. This condition is indeed far less common. We have searched the literature very carefully from the year 1800 to the present time. In this period we find reports of 30 cases of traumatic dislocation of the testis. Six of these are repetitions

and one though called traumatic is really a congenital ectopy. There are therefore reports in the literature of only 23 original cases of traumatic luxation of the testis. All of these original articles have been studied carefully and will be reported here in detail.

Before presenting these cases let us consider the various anatomical possibilities for the dislocation of a testis when forcibly extruded from the scrotum. We believe that its resultant position is dependent upon three factors: (1) anatomical abnormalities, (2) obstruction present or superimposed at the scrotal neck or in the inguinal or perineal region, but for the greater part (3) on the direction and force of the blow. In the normal individual the external inguinal ring hugs the cord snugly. Unless it is markedly relaxed or the testis itself very atrophic, the testis could not be forced up through the external ring into the inguinal canal. If the external ring is considered as the hub, it is possible after the expulsion of the testis from the scrotum to have it dislocate into any position on the circumference of the wheel, depending on the direction and force of the blow and obstruction along its path. All these migrations would be entirely subcutaneous and would give rise to positions similar to those of the congenital ectopic testis.

The accompanying diagram (Fig. 1) shows the various possible positions of the dislocated testis. On the patient's right side it is shown in the positions it might occupy if it were extruded from the scrotum but did not pass through the external inguinal ring into the canal. In this group of subcutaneous dislocations we find the superficial inguinal, the superficial abdominal or pubic, the penile, the crural and the perineal (shown in Fig. 1a), while on the left side we have shown the various possibilities if the testis passes through the external inguinal ring and into the inguinal canal. It may then be found in the inguinal or femoral canals or intra-abdominal.

It was most interesting after having theorized as to these various possible dislocations, to search the literature and find actual case reports of almost every type. We can find no records of a traumatic intra abdominal or femoral testis and except for our new case reported here, no authentic case of a crural testis in the literature as far back as 1809. All other types are found to be represented. The pubic and superficial inguinal types are, as one would expect the most common with 6 and 5 cases respectively. There are 3 of the penile and 2 of the perineal types, 3 in the inguinal canal, 3 of traumatic herniation or compound dislocation of the testis through the scrotal wall, and 1 case in which it is impossible to place the dislocation accurately. We herewith add to this list one of the crural type and one compound dislocation of the testis.

The etiological factor in all these cases was trauma. It is interesting to find that of the 23 cases 9 were the result of wagon wheels rolling over the genital and inguinal regions. In the remaining 14 cases various accidents occurred all of which were very severe and resulted in the crushing of the scrotum. The symptoms presented in most cases were immediate severe shock with nausea, vomiting and great local pain. In one case (Donovan and Ortiz) there was also marked epigastric discomfort. Examination immediately after the trauma often does not disclose the luxation because of the acute swelling, hemorrhage and pain but in a few days when the acute reactions have subsided one is able to note the absence of the testis from the scrotum and also to discover an ovoid tumor in a foreign locality. Pressure on this mass causes the peculiar testicular sensations and pain which are usually readily volunteered by the patient. Naturally either an open or closed reduction must be carried out. It is rather astonishing to find that in only 4 cases was the testis restored to the scrotum without an open operation. Six patients were not treated at all and 13 required an open reduction. All except 1 of the patients were cured but in this one it was impossible to keep the testis in the scrotum and an orchidectomy was necessary. It is also interesting to note that in only 2 cases was the epididymis torn loose from

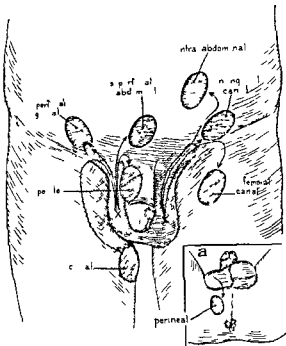


FIG. 1. Diagram showing the various possible positions in which a dislocated testis may locate. (1) Patient's right testis not passing into the inguinal canal affords the 5 subcutaneous dislocations—pubic, superficial inguinal, penile, crural and perineal (in insert a). (2) Patient's left testis has passed through the inguinal canal. This affords the possible true inguinal, abdominal and femoral testis.

the testis. In all the rest, except one in which this factor could be determined, the tunica vaginalis was intact and the epididymis uninjured. One can therefore, conclude that in traumatic dislocation of the testis the diagnosis and treatment are rather easy and the ultimate results excellent.

Let us now consider the different anatomical varieties of dislocation of the testis. There are three types. (1) The internal dislocation group—that in which the testis is forced through the external inguinal ring with the resultant inguinal canal, abdominal or femoral testis. (2) The superficial dislocation group—that in which it does not pass through the external ring but is forced subcutaneously into any position on the circumference of a circle with the external inguinal ring as the center. In this group we have the superficial inguinal, superficial abdominal or pubic, penile and crural types. (3) Compound dis-



Fig. 2 Photograph of Popow's case Paris 1888 Shows a dislocation of the right testis to the pubic region. No history. Not treated.

location—that in which there is a true herniation of the testis through the scrotal wall.

We will discuss each type and group of these dislocations and then present brief histories of all the cases of dislocation of the testis which we have found in the literature and two cases which we had this year in the Department of Urology of the Johns Hopkins Hospital. These cases have been grouped in accordance with their anatomical location.

#### INTERNAL DISLOCATION OF TESTIS—THREE CASES

It has already been stated that in order that the testis may pass back through the external inguinal ring there must be some anatomical abnormality. Either there is an atrophic testis, a relaxed external inguinal ring or the presence of an inguinal hernia with the resultant enlargement of the external inguinal ring. It is because of the requirement of one of these abnormalities that we find very few cases belonging to this group.

We have searched the literature carefully from 1800 to the present time and find only 3 cases in which the testis was dislocated by trauma into the inguinal canal. The one reported by Nicolas in 1899 is a repetition of Lee's case. Lee in 1869, in St. George's Hospital reports in London referred to a case of "Disappearance of One Testicle." This is simply a brief paragraph stating that a young man who had been wearing a truss for a left inguinal hernia, came to him because his left testis had disappeared. Although it could not definitely be felt in the inguinal canal it was presumed that it had been forced there by the pressure of the truss. He was advised to stop wearing it and in a few days the testis reappeared in the scrotum. It is of course possible that this was a true abdominal testis but it would be somewhat fanciful to suppose that the testis, having been forced into the abdominal cavity, would again so quickly find its escape. It seems more likely that the testis was in the inguinal canal near the internal ring and not palpable. The two other cases were reported by J. A. Hawkins in 1914. One was the result of a trolley injury and the other of a locomotive accident. In each case diagnosis was simple as one was able to feel the gland in the canal. Open reduction was necessary and the ultimate result excellent in each case. No history is given as to how the testis got through the external inguinal ring in one case and perhaps this should be really classified as a superficial inguinal case. In the other instance mention is made of the tearing of the structures of the external ring. Thus no doubt, allowed the dislocation into the canal. Bruns in 1883 stated that there has been several cases of this type reported by Godard, Fischer and LeDentu but we have been unable to find these articles.

**CASE 1.** Reported by H. Lee. In 1869 Dr. Cumming of Cadogan Place brought a young man to writer with the complaint that one of his testicles had disappeared. It so happened that the gentleman had a left indirect inguinal hernia for which he had been wearing a truss. The truss evidently had been worn in such a manner as to force the left testis out of the scrotum up through the external inguinal ring. The surgeon recommended that the patient should stop wearing the truss for a few days and to his great relief in a short time the left testicle again appeared.

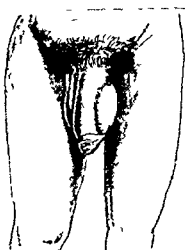


Fig. 3. Photograph of Howlett's case of penile dislocation of the testis. Shows the left testis under the skin of the shaft of the penis. Patient aged 60. Run over by wagon wheel. Not treated. (From Brit. M. J. 1890.)

in the scrotum. This is the only case on record where a dislocation was caused by indirect trauma.

**CASE 2.** Reported by J. A. Hawkins. In April 1910, J. M. aged 24 years was struck by a locomotive. He received severe shock and when brought to the hospital examination showed a contusion of the hip and a puncture wound over the left inguinal region. There was a fracture of the ilium at the left acetabulum. The left scrotum was empty. The left testis was found to be in the left inguinal canal. There was a rupture of the fibers of Poupert's ligament and a deep extraperitoneal hole leading down into the pelvis. At open operation the testis was replaced in the scrotum and the wound drained. Recovery was complete.

**CASE 3.** Reported by J. A. Hawkins. In May 1910 H. L. aged 11 years had been struck by a trolley car and thrown against the curb. Both testes had been down in the scrotum before the accident. Examination showed a badly lacerated wound over the pubis. Only one testicle present and absence of the penis. Only the skin of the penis being present. The body of the penis was found in the wound over the pubis, its skin having been torn loose at the corona. The right testis was found in the inguinal canal. Open operation was carried out and the penis was drawn through the wound and pulled into its sheath. This was sutured as in a circumcision and the wound over the pubes drained. The inguinal canal was opened and the testis replaced into the scrotum. The result was excellent.

As to the two remaining types in this group, the abdominal and femoral we have been unable to find a single authentic case. Claubry, in 1818 reported a case as *Observation*

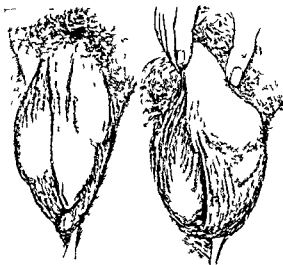


Fig. 4. (left) Guiteras case of penile dislocation of the testis. Anterior view. Patient aged 52 run over by a wagon wheel. Open reduction. Well. (From Med. Rec. 1898.)

Fig. 5. Photograph of the same case as in Figure 4. Penis is raised to show the swelling on left side and under surface of the penis caused by the dislocated testis.

*sur une retrocession subite des deux testicules dans l'abdomen*, but a careful review of this report leaves no doubt but that it belongs to the superficial abdominal or pubic type. He states that the testes could be easily palpated behind the pillars of the oblique muscles. If they had been intra abdominal this of course, would have been impossible. Congenital abdominal testes are not by any means rare but we can find no case of traumatic abdominal testis in the literature. We are not surprised to be unable to find a case of a femoral testis. It would be most unusual for a traumatically dislocated testis to travel into the abdomen and then pass downward again through the femoral ring to lie under the cribriform fascia in the femoral canal.

#### THE SUPERFICIAL ABDOMINAL OR PUBIC TYPE OF DISLOCATED TESTIS—SIX CASES

The most common group of luxated testes consists of those in which the testis is dislocated subcutaneously to a position on the circumference of a circle the center of which is the external inguinal ring. There are various types in this group and the number of clinical cases reported in each type is given



Fig. 2 Photograph of Popow's case Paris 1888 Shows a dislocation of the right testis to the pubic region No history Not treated

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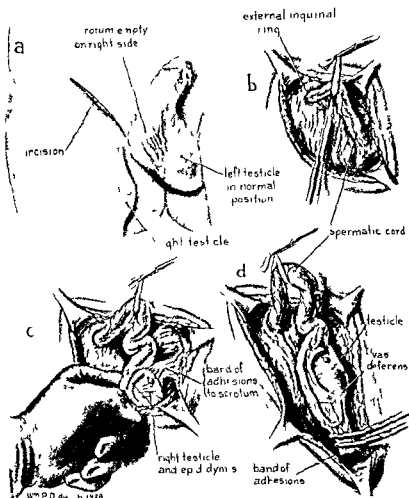


Fig 7 Case 1 D S BUI 17404. Writer's case. Drawings at operation. a Left testis in scrotum. Right testis dislocated to right crural region. Right scrotum empty. b External inguinal ring, exposed. Spermatic cord coming out of ring. Separation of adhesions around the cord. c The right testis drawn up to cruroscrotal region. Adhesions to medial subcutaneous tissues. Tunical vaginalis opened. d Incision enlarged and retracted, showing dense adhesions in region of gubernaculum. Vas deferens shown passing far down into adhesions.

complained of severe pain in the lumbar region. Examination disclosed the fact that his right testicle was not in the scrotum. There was considerable contusion of the penis and scrotum. A little to the left of the midline directly above the pubis was a small tumor about the size of a testis. An ice cap was applied. Three days later swelling and contusion had improved so that testis could be easily palpated. On this day by digital pressure it was possible to restore the right testis to its proper place in the right scrotum. It is interesting to note here that the right testis had been forced across the midline to lie in the left suprapubic region and in spite of this marked displacement a closed reduction

was possible as it was done 3 days after the accident. CASE 6. Reported by P. Bruns. A well developed man of 33 years was run over by a wagon wheel November 1887. The wheel passed over his abdomen and scrotum. He was unable to rise and was rather severely shocked. No external wound was present but the scrotum and right side of the pelvis were markedly swollen. Examination 4 weeks later showed an old fracture of the pelvis with suppuration present. The right testis was not in the scrotum but was found under the skin of the pubis. It was of normal size and produced normal testicular sensation upon pressure. The cord could be palpated from the displaced testis to the external inguinal





Fig 6 Photograph of Krausch's case. Leipzig 1925. Shows a penile dislocation of the testis. Lateral and anterior views. Patient aged 20. Auto wheel passed over scrotum and lower abdomen. Open reduction. Well

hereinafter. The pubic and superficial inguinal types are the most common. This is as should be expected, inasmuch as a direct blow of the passage of a wheel over the scrotum and lower abdomen would force the testis up out of the scrotum and then, depending upon the direction of the force and the presence of obstruction it would slip supra pubically or up toward the inguinal region. If it met obstruction to the inguinal path it would turn medially and travel toward the suprapubic region becoming a pubic testis. We found 6 original authentic cases of the superficial abdominal or pubic type in the literature. The first was reported by E. C. Claubry in 1809 as a case of abdominal testis. This however was an error as we have already pointed out. It was evidently directly over the pubis in the midline. P. S. Conner in 1877, reported a similar case in which the testis had been forced suprapubically and then across to the opposite side beyond the midline. Bruns in 1883 reported a similar case. In 1888 Popow reported a case of traumatic pubic ectopia. Figure 2 is a photograph of his case. The testis is shown at the root of the penis under the skin of the mons veneris. Popow was unable to find a similar case except that of a tailor in Moscow. We cannot however, find any authentic report of this particular patient. Nicolas and Donovan and Ortiz each reported one case. In all these cases the age naturally, has no significance, but it is most interesting to note that in this group, four of the six dislocations

were the result of the passage of wagon wheels over the genital and inguinal regions. One was the result of a fall and in one the accident is not described. Diagnosis of this type is easy, particularly after the acute swelling and symptoms have subsided. It so happens that in this group of 6 cases in no one was the epididymis torn loose from the testis nor the tunica vaginalis injured. All the surgeons attempted closed reductions except Popow and Claubry who gave no treatment as their patients were not suffering from the dislocations. Conner reduced his case successfully without open operation. The reason for his success, we think, is due to the fact that he attempted the reduction on the third day after the accident. This is most important for after the testis has developed adhesion to the surrounding structures, closed reduction is out of the question. Bruns attempted a closed reduction but as it was then 4 weeks after the injury it was unsuccessful. Donovan and Ortiz and Nicolas performed open operations on their cases and with excellent results. The histories of 6 cases of this type are given briefly.

#### SUPERFICIAL ABDOMINAL OR PUBIC DISLOCATED TESTIS

CASE 4. Reported by E. G. Claubry. The patient was a soldier 20 years old who in May 1809 fell from a wagon. He landed on his back and one of the wheels of the wagon passed across his scrotum and lower abdomen. He received a violent contusion of the abdominal wall and scrotum. He was cured of his contusions and 3 months later appeared in the Military Hospital. The testicles were absent from the scrotum. They were found and could be easily palpated in the suprapubic region near the internal pillars of the oblique muscles. The patient was complaining of sharp pains in the lumbar region and walking was difficult and painful. He was obliged to bend forward with his body flexed on his thighs when walking. The author was of the belief that this condition was due to the spontaneous retraction of the testes which was caused by the violent contracting of the abdominal muscles at the time of the passage of the wheel over the abdomen. This is difficult to believe; it seems far more likely that it was due to the direct force of the trauma. No treatment is mentioned.

CASE 5. Reported by I. S. Conner. This patient was a teamster in the Quartermaster's Department of the U. S. A. December 17, 1861 the patient came to the Columbia Hospital, Washington, D. C. The wheels of a heavy wagon had passed over his inguinal region. He was not in severe shock. He



FIG. 9. Case EDS BUI 17804. a (left) On admission testis location is shown by A in crural region. Testis is forced upward as far as possible held between second and third fingers. b Ten days after operation. On discharge right testis is seen in the scrotum.

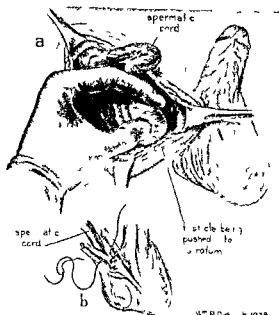
kicked in the perineum. One was crushed between logs and the remaining one suffered from a fall. In three cases there at once resulted a swollen, tender mass in the region of the scrotum, probably the result of oedema and hæmorrhage. This subsided in a few days and then the absence of the testis was discovered. In two cases the testis was noticed at once as a small tumor in the inguinal region, a short distance above the external inguinal ring and directly under the skin and subcutaneous tissues. Pressure on this small ovoid tumor elicited characteristic testicular pain. In three cases the epididymis was not torn loose from the testis but the testis in its tunica vaginalis along with the epididymis had been displaced *in toto* and uninjured. Poisson and Frederick make no mention of this finding, but we gather from the text that this was also the condition in their patients. Treatment in these cases was similar to that of the pubic type. Four cases were cured by operation. In one case a closed reduction was attempted but was unsuccessful and nothing further done. Glauden's case was bilateral; one testis he was able on the fourth day after the accident to replace and fix in the scrotum.

Upon the other he had to do an open reduction. The results in all the cases as of those in the previous type were excellent.

The following are summaries of the case histories.

**CASE 10.** Reported by Hess. The patient is a man 31 years old who fell from a cannon August 15 1873. The wheel of the carriage passed over his body and left leg. He had severe pain in the scrotum and felt faint. He was taken to the hospital and cold compresses were applied. Two days later examination was more satisfactory. A large ecchymosis of the left thigh extended from the knee to the groin. The scrotum was not extremely swollen. The right scrotum was empty and there was a tumor the size of an almond in the right inguinal region; the author states  $2\frac{1}{2}$  centimeters from the inguinal fold. Pressure on this tumor produced testicular sensation. Three days after the accident the swelling had gone down considerably and the swelling was not nearly so tender. It was possible at this time to perform a closed reduction. Result excellent.

**CASE 11.** Reported by A. D. Keith. On April 1 1893 a farmer W. Va. while training a young horse yoked to a farm cart was suddenly thrown to the ground and the wheel of the heavy cart passed diagonally across his body from the left foot to the left anterior superior spine of the ilium. There was considerable bruising and tumefaction of the right scrotum and groin. The right testis could not be felt in the scrotum. Two days later the swelling had



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FIG. 8. Case L.D.S. BUI 1,804. Drawing at operation. a Testis and cord entirely freed from adhesions and being slipped into scrotal sac. b Three sutures placed through cremaster and dartos to draw them tightly around the cord. This retains testis in scrotum. Final location of testis in normal position.

ring. There was no separation of the epididymis from the testis. An unsuccessful attempt was made at a closed reduction. This is not surprising as it was then 4 weeks after the accident. Nothing further was done. A year and a half later the patient was again seen and conditions remained exactly as before. The patient was not complaining of any pain or discomfort from this condition.

CASE 7. Reported by W. Popow. The author gives no history in this case but presents the photographs of a dislocated testis to the pubic region. He shows the left testis to lie at the root of the penis at the lower part of the pubis. It was normal in shape and pressure caused testicular sensation. The epididymis was not separated from the testis and the spermatic cord could be traced back to the inguinal ring. The author had never seen nor heard of a similar case, but on writing to other surgeons he found one case of a tailor in Moscow who had a similar condition which was evidently the result of an injury in infancy. There is no mention of any treatment of this case.

CASE 8. Reported by M. Nicolas. This patient was a man 32 years of age who fell from a heavily loaded wagon and the wheel passed over his scrotum. He lost consciousness and was taken home. Large ecchymosis of the scrotum and swelling extended to the suprapubic region which was thought to be due to hemorrhage. He was put to bed and cold compresses

were applied but pubic swelling did not entirely disappear. He was taken to the hospital where examination showed a small ovoid tumor directly over the pubis which was movable and very painful on pressure. They then noticed that the left scrotum was empty. The spermatic cord could not be found. Open reduction was done. The testis was found uninjured and directly over the pubic symphysis. It was replaced in the scrotum and the result excellent.

CASE 9. Reported by R. E. Donovan and M. Contreras Ortiz. This patient was a man who suffered a fall from horseback September 20, 1920. He immediately had very sharp pain in the left scrotal region. On trying to rise he fainted. Ice bags were applied to the region but with no improvement. He entered the hospital where he stayed for 2 months at the end of which time he was pronounced cured. However the patient noticed that his testis was not in the scrotum but rather in the pubic region. He was advised to have no treatment. However, on the first occasion when he rode horseback he had very severe pain in the epigastrium which was so bad he could hardly breathe. There was severe nausea and vomiting. Several other attempts at riding resulted in the same discomfort. He was again taken into the hospital where examination showed the inguinal rings to be normal. The left testis was absent from the scrotum and was found to lie in the upper border of the pubis. The epididymis was felt to be normally attached to the testis. Pressure on the testis and pulling it downward gave exactly the same experience of pain in the epigastrium of which he had previously complained. An open reduction was done, a small testis lying over the pubis was found very markedly adherent to the surrounding structures. The testis was replaced in the left scrotum and the result excellent. In this case also since several months had elapsed between accident and operation a closed reduction was impossible.

#### SUPERFICIAL INGUINAL TYPE OF DISLOCATED TESTIS—FIVE CASES

The next most common type of this subcutaneous group is the superficial inguinal. This dislocation depends mostly upon the direction of the force of the blow. The testis, not being able to pass through the external inguinal ring, slips up on top of the aponeurosis of the external oblique muscle. There are seven such cases reported in the literature, but the ones by Bruns and Nicolas are repetitions of Hess' case so that there are really only 5 authentic original cases. One each by Hess in 1874, Keith in 1898, Frederick in 1912, Poisson and LeRat in 1912, and Glaudea in 1922. In these we find that the passage of a wheel over the scrotum accounted for two of the dislocations. One patient was

1896 respectively. Similarly, the case reported by Lewis in the *St. Louis Clinique* is that of Guteras. The earliest one recorded is that of E. H. Howlett in the *British Medical Journal*, of 1890. It consists of a short report with a drawing of the condition, a photograph of which is our Figure 3. The testis is shown far down along the side of the penis. From his description, the testis must have been torn from the epididymis. It is interesting that this feature is present in this and one other penile type case, that of Guteras. In all the other dislocations, the epididymis was luxated along with the testis and not separated from it. Howlett's case was of 4 years' duration and since it afforded the patient no discomfort, no attempt at reduction was made. Guteras published his case 6 years after Howlett. This one is recorded quite fully with two illustrations, photographs of which are Figures 4 and 5. The testis, which had been torn loose from the epididymis and ruptured through the tunica vaginalis, was lying under the dartos sheath of the penis. In 1897, Poupert reported a case, but it is without doubt not a traumatic dislocation but rather a congenital ectopic testis of the penile type. In 1925 Krausch reported another traumatic luxation of the testis. Photographs of his case are in Figure 6. These two views show the testis on the under surface of the penis. The testis was not torn loose from the epididymis. Aspiration of this tumor identified it and open reduction was accomplished. It is most interesting to note that these 3 cases were the results of very serious and terrific trauma much more so than that of the previous types of dislocation. Diagnosis also in this group is more puzzling and often is not evident for several days. The symptoms were not so marked nor peculiar except for the fact that these patients did not have any erections, due to the presence of the gland in the penis causing pain when erection began. All these cases were caused by wheels passing over the genital region. Open reduction was necessitated in two cases and the results obtained were excellent. The remaining case was not treated.

Brief histories of the cases of the penile type of dislocation follow.

**CASE 15** Reported by E. H. Howlett. The patient, W. C., aged 65 years, laborer, came to the author in 1886. He had been knocked off a wagon, the wheels of which had passed obliquely over the left side of abdomen and scrotum. In addition to the spinal symptoms for which he came for treatment, it was noted that the left testis was absent from the scrotum. It was found to be lying on the left side of the body of the penis directly under the integument. The epididymis could be felt near the external inguinal ring. It had evidently been torn loose from the body of the testis at the time of the accident, but was still connected to it by the vas. The testis seemed normal in size and consistency and pressure gave the usual testicular sensations. The patient was not inconvenienced particularly by this dislocation. It had been four years since the accident, and during this time he had had no erections. This patient was not treated. This and one other penile dislocation are the only cases in which the epididymis was torn loose from the testis.

**CASE 16** Reported by R. Guteras. J. C., aged 52 years, a piano mover, 2 months previous to admission had fallen from a wagon and had the wheel pass between his legs and up over the left groin. There was severe pain and considerable shock. He was taken to a hospital where the house surgeon found a fracture of the sixth and seventh ribs, contusion of the left hip, laceration of the left pubic region with considerable hemorrhage. Later in the day it was noticed that his penis and scrotum were very swollen and ecchymotic. Ice cap was applied to the genitals. At the end of a week the swelling and pain had diminished so that a more careful examination could be made. However the dislocated testis was not noted. He remained in the hospital 3 weeks and improved greatly, although his penis felt sore and sensitive. When leaving the hospital he still was quite weak and had to support himself on crutches. He still remained in bed because of his pain, nausea and vomiting on rising. He was referred to the author. At this time his general condition was good and he felt quite well except for pain and discomfort in the penis which was very marked when he moved around. On questioning he stated that he had had no erections since the accident, and at times urination was painful. The penis was flattened and abnormally wide at its base where it measured  $5\frac{1}{2}$  inches in circumference. The left side of the organ was bulging from behind the glans to the pubes and in this region an oval mass was felt which had a peculiar elastic consistency resembling that of a testis. This mass was connected to a nodular mass at the peno-scrotal junction on the left. Palpation of the nodular mass revealed an elongated body extending down into the scrotum, where it again became slightly expanded. A diagnosis of dislocation of the testis was made and closed reduction was attempted, but due to the long time since the accident this was impossible. An open reduction was then carried out. The mass in the penis was found to be the testis and

Wm P. D. Jones, Jr.  
1919

left testis

Fig 10 H J B U I 18265. Writer's case of compound dislocation of the testis. The testis and epididymis uninjured and surrounded by their intact tunica vaginalis are extruded from the scrotal sac. The shaded part of the tunica vaginalis shows the scarification and superficial hemorrhage due to trauma.

abated and one was then able to feel a small ovoid tumor over the right inguinal region pressure upon which caused testicular pain. Closed reduction was attempted unsuccessfully. Twenty-seven days after the injury an open reduction was done. The testis with the surrounding epididymis was found living in its tunica vaginalis underneath the superficial fascia in the inguinal region. A nodule was found in the scrotum which proved to be an old hematoma. The testis with epididymis was replaced in the right scrotum and sutured to the bottom of the scrotal sac. The result was excellent.

CASE 12. Reported by Frederick (Canadian Lancet 1912). This patient received a heavy fall to the ground which caused severe injury to the scrotum and dislocation of the testis. It was found in the inguinal region but could not be replaced in the scrotum. Open reduction was necessary and after the severance of dense adhesions it was anchored in its normal position.

CASE 13. Reported by Poisson and LeRat. A farmer 18 years of age presented the following history. At the age of 6 he had been kicked in the perineum and since that time had suffered periods of sickening pain in the right inguinal region. Because of these symptoms he came to the surgeon at the age of 18. Examination showed that there was only one testis in the scrotum. The other testis was located

in the superficial inguinal region. Doctors previous to this time had thought that this tumor was a hernia. However pressure on the mass produced typical testicular sensations. The parents state that previous to this injury both testes had been normally in the scrotum. An open reduction was accomplished and a normal testis was replaced in the scrotum.

CASE 14. Reported by C. L. Claude. The patient J. F. W. aged 32 previous to the accident had passed army examination. While working on a log train he got caught between 2 huge logs which compressed his abdomen and upper thighs. On admission to the hospital he was severely shocked with weak thready pulse of 140. Nausea and vomiting. His complaint was "I ruptured myself." The patient's face had a rather pinched expression. The abdominal muscles held rigid. The scrotum was the size of a baseball, was markedly discolored and felt soft as if a blood clot were present. No testes were felt in the scrotum. Ovoid tumors were present in both inguinal regions and pressure on them produced testicular pain. The third day after the accident it was possible to replace the right testis into the scrotum. The left testis however was too adherent and 8 days later an open reduction was carried out. The testis was found lying upon the external oblique aponeurosis. There was no visible damage to the epididymis or vas and after freeing a few adhesions the testis was replaced in the scrotum. The patient is well.

#### PENILE TYPE OF DISLOCATED TESTIS—THREE CASES

Consider now the possibility of the testis being forced upward anteriorly out of the scrotum. When it arrives at the penoscrotal juncture it meets with obstruction so that it cannot pass either up over the inguinal region or suprapubically. It then has two possible paths open, medial or lateralward. If it passes laterally it slips under the subcutaneous tissues of the scrotum connecting that of the thigh. It would then lie in the crural region. If it passes medially it must then slip downward under the integument of the penis and belongs to the penile type.

As one would expect we found fewer or only three original cases reported of this type of dislocation. There are 7 cases of penile luxation of the testis reported in the literature, but 3 of these are repetitions and one without doubt is a congenital ectopic testis. The case reported by J. D. in *La Presse médicale* is the same as that of Krausch and the two reported by Nicolas in 1899 are those of Howlett and Guterus published in 1890 and

TABLE I SUMMARY OF TYPES

Type of dislocation	Author	Date reported	Age	Nature of trauma	Separation of epididymis from testis	Treatment	Result
1 Pubic	Claubry Conner Bruns P. pow Nicolas Donovan and Orin	1818 1877 1884 1888 1890 1925	20 ? 33 ? 32 ?	Wagon wheel Wagon wheel Wagon wheel ? Wagon wheel Fall	No No No No No No	Not treated Closed reduction Not treated Not treated Open reduction Open reduction	Well Well Well Well Well
2 Superficial inguinal	Hess Klein Frederick Fousson and LeRat Glauden	1874 1895 1912 1912 1912	31 ? ? 18 32	Wagon wheel Wagon wheel Fall Kicked in perineum Crushed between logs	No No No No No	Closed reduction Open reduction Open reduction Open reduction Bilateral (1) closed reduction (2) open reduction	Well Well Well Well Well Well
3 Inguinal canal	Lee Hawkins Hawkins	1869 1914 1914	25 24 17	Wearing truss for inguinal hernia Locomotive injury Trolley car injury	No No No	Closed reduction Open reduction Open reduction	Well Well Well
4 Penile	Howlett Gutera Krausch	1890 1900 1910	65 52 20	Wagon wheel Wagon wheel Auto wheel	Yes Yes N	Not treated Open reduction Open reduction	Well Well Well
5 Perineal	Ladd Simpson	1858 1914	24 23	Riding horse back Struck in scrotum	No No	Open reduction unsuccessful Not treated	Orchidectomy
6 Crural	Writer's case	1928	20	Auto accident	No	Open reduction	Well
7 Compound dislocation	Van Hassel Sumner N. Clair Writer's case	1894 1896 1914 1920	20 20 ? 45	Crushed between logs Crushed between logs Gun shot Auto accident	No No ? N	Open reduction Open reduction Open reduction Open reduction	Well Well Well Well
8 Femoral	No authentic true cases found in the literature						
9 Abdominal	No authentic true cases found in the literature						

to sleep. On admission he gave evidence of great suffering while his gait was suggestive of perineal distress. Pulse rapid and thready. His scrotum, testes and perineal region were markedly tender, sensitive to touch, and ecchymosis was present. Left testis was found in normal position slightly enlarged and tender, while the right was absent from the scrotum but could be palpated back under the skin of the perineum. The cord was stretched tightly from the anterior pole of the tumor to the external inguinal ring and gave pain on pressure. The perineal tumor could be easily replaced in the scrotum and by so doing pain and discomfort immediately disappeared only to return with the recurrence of the dislocation which readily took place. An attempt was made to retain testis in normal position by adhesive straps around the scrotum but the organ immediately glided from under the dressings to its previous position in the perineum and with return of all the symptoms. He was transferred to the ward but unfortunately escaped from the hospital probably from fear of operation.

#### CRURAL TYPE OF DISLOCATED TESTIS

We were unable to find a single case in the literature belonging to this type, but fortunately we had such a case in our clinic this year which we will present. When the luxated

testis meets obstruction at the penoscrotal juncture and the direction of force is such as to drive it upward and inward we have the previously described "penile testis." On the other hand if the force drives it upward and outward with obstruction present over the inguinal region we have the crural testis. The gland slides subcutaneously over the fibrous bands between the crural region and the scrotal neck. It then comes to lie on top of the fascia lata of the thigh. Just how far down it may travel would depend on the length of the vas and cord and the force of the blow. There is a case reported by Hess in 1874 which was again published by Bruns in 1883 and by Nicolas in 1899, which was thought to be crural in type but on careful analysis of the case, it is quite clear that it is not a crural testis but belongs rather to the superficial inguinal type. As they say, "the testis had been forced into the inguinal region and lay on the thigh 2.5 centimeters below the groin." This distance is so short that it can hardly be called a true crural testis. There is mention made by Nicolas of

a nodular mass in the penoscrotal junction, the epididymis, which extended down into the scrotum. This evidently had been torn loose from the testis. The testis was replaced in the scrotum and the epididymis sutured around it. The result was excellent.

**CASE 17** Reported by Krausch. A man 20 years of age riding a bicycle was hit by an automobile which threw him to the road and caused injury of the inguinal pubic region. On admission there was a large hematoma in the region of the perineum and scrotum. Examination was very difficult. Several days later the swelling had gone down and it was then noticed that the testis was not in the left scrotum. It was also noted that on the left side of the penis there was a swelling caused by an ovoid tumor directly under the skin. This tumor did not reduce in size after several days. Puncture was made of this tumor and testicular tissue obtained. An exploratory operation was then carried out and testicular tissue was diagnosed. The testis was then replaced in the scrotum. Result excellent.

This is the same case as that reported by J. D. in *La Presse médicale*.

#### PERINEAL TYPE OF DISLOCATION OF THE TESTIS—TWO CASES

Anterior obstruction at the penoscrotal junction and the direction of the blow being such as to force the testis backward it slips down subcutaneously into the perineum and lies usually a few centimeters anterior to the anus and to one side of the central tendon of the perineum. The usual position is shown in the insert (a) of Figure 1. The congenital perineal testis is not a rare occurrence, we have found well over 100 cases reported in the literature. There are, however, only two original reports of cases of traumatic perineal dislocation of the testis. The first was by W. Liddon in 1858. The patient was an artilleryman and was thrown forward while riding on the pommel of the saddle. He fell from his horse and was severely shocked, and vomited for several minutes. The next morning he noticed an extremely tender tumor in the perineum about 1 inch anterior to the anus. Several closed and open operations were attempted to maintain the testis in the scrotum, but each time it slipped back into the perineum. An orchidectomy was therefore done. As you have noticed, this is the first and only case in which an orchidectomy was necessary in all of the different types of testicular dislocations. The other case of traumatic peri-

neal testis is that reported by Simpson in 1914. His was a man of 23, who ran with considerable force against a table, the corner of which struck him directly on the scrotum. The right testis was dislocated backward to lie under the skin of the perineum. Its position gave him a lot of pain and discomfort. It was easily replaced into the scrotum and with complete relief of symptoms. However, it was impossible to keep it there by strapping. Unfortunately, he left the hospital before an open reduction could be done and he was lost track of. There is one other case reported belonging to this type, by Bruns in 1883, but it is the same case as that reported by Liddon in 1858. The interesting features of the perineal dislocation are its extreme rarity, the force of the blow must be directly anteroposterior to the body, and it seems that a successful result is much more difficult to obtain as neither of these cases was cured. This is exactly opposite to the results obtained in all the other types of dislocation.

**CASE 18** Reported by W. Liddon. Patient B. S., aged 24 years, was admitted to King's College Hospital April 30. He was a soldier in the artillery who 2 years ago was thrown forward while riding on the pommel of the saddle. His scrotum was injured and he fell from the horse. There was nausea and vomiting. The next morning he noticed a swelling in the perineum which was so painful that he could hardly move. He went to the hospital for treatment for 3 months without benefit. The testicle merely slid back and forth between scrotum and perineum until it now lay one inch in front of the anus a little to one side of the midline. The testis had diminished in size and was smaller than the right. At times he had difficulty in urinating and was unable to work. An open operation was therefore attempted to replace the testicle into the scrotum and to retain it there. However, 3 weeks after operation the testis had gradually slipped back to its old position. A second attempt was therefore made to anchor it into the scrotum; this was also unsuccessful. Therefore an orchidectomy was carried out. It will be noted that this is the only one of all the cases of dislocation of the testis in which a castration was necessary.

**CASE 19** Reported by J. C. Simpson. M. S., aged 23 years, came to the Episcopal Hospital Philadelphia November 7, 1913, with history of having run with considerable force into the corner of a table 12 hours previous. The table struck him directly in the scrotum and he had immediately suffered shocking pain in the region of the testis. There was nausea and vomiting and he was unable

tion the right testis was situated normally in the scrotum and there was no sign of injury to the upper thigh (Fig 9b)

#### COMPOUND DISLOCATION OF THE TESTIS— FOUR CASES

There remains for discussion one other group of cases which for lack of better terminology has been called herniation of the testis. We feel that this type of case should more appropriately be called "compound dislocation of the testis." In these cases there is always a tear in the scrotum, and the testis together with a part of the cord is extruded through this opening and lies outside of the scrotum. The tunica vaginalis may or may not be opened and the epididymis may be torn from the testis or be entirely uninjured. It seems to us that there must occur many such industrial accidents, but to our surprise we found only three cases reported in the literature. This is probably because most surgeons have not bothered to report them. During the past month, while this paper was being written, there came to the accident room of the Johns Hopkins Hospital just such a case.

The etiologic factor is always trauma and usually such as directly to lacerate the scrotum and at the same time to compress it from above downward so as to force the testis out through the newly made opening. One case however, reported by Summerhayes in 1896 was due to indirect violence. While at work the patient fell from a height and was crushed by a heavy log. His thighs were forced together with such violence that his scrotum was torn and the testis, together with the epididymis and a short length of cord, was extruded from the scrotum. In this case, as in one other the tunica vaginalis was ruptured. In the two remaining cases, by Van Hassel in 1894 and Mauclore in 1914, the dislocation was the result of direct violence.

In the case reported by Van Hassel the tunica vaginalis had been ruptured and the testis and cord were torn and bleeding. They were cleaned with iodine and replaced into the scrotum. In Mauclore's case the tunica was not ruptured as was the condition in our patient. The treatment of thoroughly cleaning the testis and cord with a good antiseptic,

iodine in these three cases and an alcohol acetone solution of mercurochrome in our case, removing any loose necrotic tissue, replacing the testis in the cleansed scrotal sac, and draining the wound, gave excellent results in all these cases.

**CASE 21** Reported by Van Hassel. The patient was a man 20 years old who had just been in an accident in a coal mine. His scrotum had been caught between a pulley and a piece of wood. Examination showed the penis to be normal, the right side of the scrotum normal. In the left lower portion of the scrotum there was a small opening through which the spermatic cord protruded for a distance of 8 centimeters. It was contused and swollen and the left testicle which was also out of the scrotum was torn and bleeding. The testis was covered with coal dust. It was washed and cleansed with sublimate. On the fifteenth day after the accident, operation was carried out, the tunica vaginalis was detached and removed. The scrotum was closed and drained and the testicle replaced in its position. Recovery excellent.

**CASE 22** Reported by J O Summerhayes. A strong muscular man aged 20 years, sawing a heavy block of wood, fell, and the heavy log crushed him underneath it forcing his two thighs together. When he came to the hospital he was considerably shocked. His left testis was extruding from the scrotum. The tunica vaginalis had been ruptured and testicle had been dislocated through this and through the skin of the scrotum also. There was also a fracture of the neck of the femur. Operation was performed, the testicle was returned to its normal position and the wound healed quite satisfactorily.

**CASE 23** Reported by P Mauclore. Patient was a soldier who was shot while lying down. The bullet had removed part of the penis near the glans and a large part of the left scrotum. Two days later the patient showed a rather extensive gangrene of the scrotum and a complete herniation of the testis. The testis was disinfected with tincture of iodine and replaced in the scrotum. Primary wound healing was obtained. Result was excellent.

**CASE 24** During the last month there came into the accident room of the Johns Hopkins Hospital a man of 45 (H J B U I 1326c). He was deeply under the influence of alcohol so that no history at that time was obtainable. Subsequently, we have learned that he had been struck by an auto and thrown against the curb. Patient was not in a state of shock, but was rather stuporous. This we thought was the result of the cheap liquor or floor polish it often being hard to distinguish between the two which he had quite evidently been enjoying. There was a comminuted fracture of the left wrist, lacerations around the eyes and nose, and evidence of injury to the middle third of both legs. There was also a small laceration in the left scrotum about 4 centimeters in length through which the testis still enclosed in the



another case of dislocated testis in the upper part of the thigh. This was caused by the pressure of a truss worn for a hernia, and we think it was most probably an inguinal testis. As no description at all is given it certainly cannot be classified as a true crural testis.

The following case report is of a man whom we had the opportunity to study in our clinic this year. So far as we have been able to discover it is the only authentically reported case of true traumatic crural dislocation of the testis.

#### A CASE OF TRUE CRURAL DISLOCATION OF THE TESTIS—FIRST AUTHENTIC CASE

**CASE 20.** On September 10, 1923, there was admitted to the Brady Urological Institute of the Johns Hopkins Hospital a young man, (F D S, B U I 17804) with the complaint that his right testicle had disappeared from his scrotum. His family and past history were unessential except for the fact that he had been a perfectly normally developed individual before the present illness. Both testes had been present normally situated in the scrotum. There had been no hernia present. His present illness dates from an auto accident 5 months before admission, at which time he had been badly injured. His pelvis had been fractured; there had been a dislocation and fracture of the head of the right femur. A left direct inguinal hernia had resulted and there had been a very severe laceration in the perineum extending from the anus to the penoscrotal juncture. He had been treated for these injuries in a local hospital where it had also been noticed that his right testis was not in the scrotum. A search had located it on the inner surface of the right thigh over the region of the apex of Scarpa's triangle. Several attempts at a closed reduction had been made a few weeks after the accident, but all had been unsuccessful.

The young man was apparently in good health except for the residuum of his old injuries. A left direct inguinal hernia, a relaxed left hip joint, a scar in the perineum, and an ectopic right testis. There was no indirect inguinal hernia present nor was either external inguinal ring relaxed. No impulse was felt in the region of the femoral ring or canal, but lying subcutaneously below and medial to the fossa ovalis at about the apex of the femoral triangle was an ovoid tumor (Fig. 7a). This could be moved upward toward the external ring for a distance of 8 to 10 centimeters but not sufficiently high to slip it over into the right scrotum. Pressure on it elicited typical testicular pain. Its consistency and size were that of a normal testis. The epididymis could be distinguished in its normal relationship to the gland. The vas and cord were easily made out extending from the external ring to the ovoid tumor. There was no testis in the right scrotum. The left was in

its normal position. There was no doubt, therefore, that this was a case of traumatic crural dislocation of the right testis. At the time of the accident the right testis must have been dislocated from the scrotum and arriving at the penoscrotal juncture it must have met obstruction to passage either medial, inguinal, or penile and the force and direction of the blow were such as to push it down under the subcutaneous tissues of the thigh until it came to lie over the fascia lata in the region of the apex of the femoral triangle. It lay exactly 12 centimeters below the right external inguinal ring.

Attempt was made to replace this testis into the right scrotal sac but there evidently were present dense adhesions which prevented us from doing this. Ethylene anesthesia was then given and again an attempt was made at a closed reduction but this was equally unsuccessful. An open reduction was therefore carried out. Incision was made similar to that for an indirect inguinal hernia repair except that it extended downward farther toward the cruroscrotal fold (Fig. 7a). As the subcutaneous tissues were retracted there appeared a perfectly normal spermatic cord coming out of the right external inguinal ring (Fig. 7b) but instead of coursing downward into the scrotum it turned laterally and descended beneath the subcutaneous tissues of the thigh. Attached to the end of the cord was a perfectly normal sized testis and epididymis still enclosed in its uninjured tunica vaginalis. The testis lay 12 centimeters below the external inguinal ring on top of the fascia lata and at about the apex of the femoral triangle. It could be easily forced upward as far as the cruroscrotal region, but not over into the right scrotal sac, due to dense adhesions which bound the region of the globus minor to the fascia lata at a distance of about 10 centimeters below the spine of the pubis. These dense adhesions were attached in the region of the gubernaculum testis (Fig. 7c). Great care was taken in freeing these adhesions as the vas lay in the midst of them. The tunica was opened during this dissection and resected so as to prevent the possibility of a future hydrocele (Fig. 7d). After complete delivery of the testis there was quite a sufficient length of cord and vas to replace the gland into its normal position in the right scrotal sac which had been made ready to receive its "prodigal son" (Fig. 8a). The permanent normal position of the testis in the scrotum was assured by the tissues of the dartos at the neck of the scrotum being drawn snugly around the cord. This is similar to the method of Young in performing an orchidectomy (Fig. 8b). Three sutures of medium black silk were used to make the testis secure. The wound was closed in the usual manner with black silk. A dressing was then applied with pressure at the scrotal neck and over the crural region so as to assist in preventing the testis from slipping out of the scrotum and to obliterate the dead space in the upper part of the thigh from which the testis had been removed. The wound healed *per primam* and on discharge, 10 days after opera-

anatomical abnormalities, (2) obstruction to dislocation in particular directions, and (3) the direction and force of the blow

6 There are three groups of cases the internal or those in which the testis passes through the external inguinal ring into the canal, the superficial or those in which it does not pass into the canal but lies subcutaneous, and the compound dislocation of the testis

7 In the first group are the femoral and inguinal canal and abdominal types

8 In the subcutaneous group we have five different types, pubic, superficial inguinal, penile, perineal, and crural

9 The etiological factor was in the majority of cases, the passage of a wheel over the genital region

10 Symptoms were severe shock and local pain with nausea and vomiting

11 Diagnosis was usually very easy, after the traumatic swelling had disappeared Early diagnosis was often very difficult

12 In only two cases, both penile, was the epididymis torn from the testis

13 Treatment was very satisfactory, reduction without open operation was accomplished in only 3 cases, open reduction in 16 Six cases were not treated

14 All the cases were cured except one perineal testis which could not be held in its correct position and had to be removed

15 There were only 3 authentic cases reported in which the testis had been dislocated within the inguinal cord These were associated with some previous anatomical abnormality

16 There were no cases of traumatic femoral or abdominal testes on record

17 There were 6 cases of the pubic type this being the most common Three were not treated and 3 were cured by open reduction

18 The superficial inguinal type comes next with 5 cases One case was not treated, all the others were cured by open reduction

19 There were 3 penile dislocations One was not treated and the two others cured by open operations

20 Only 2 cases of traumatic perineally dislocated testis were found One was not treated and the other necessitated orchidec-

tomy as it could not be retained in the scrotum This is the only patient in all the cases of dislocations not cured by operation

21 There is no authentic case of a true traumatic crural testis on record The new case reported here, we believe, is the first Open reduction was easily done and a cure obtained

22 Herniation, or as we have called it, compound dislocation of the testis, must be rather common although there are only 3 cases in the literature A new one is reported in detail

23 The prognosis in all these dislocations of the testis is excellent

I wish to thank Dr Hugh H Young for his many helpful suggestions in writing this paper

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unopened tunica vaginalis was protruding together with approximately 8 centimeters of the cord. There was present practically no local hemorrhage or oedema. A drawing made at the time of admission is shown in Figure 10.

Due to the narcosis already present no anæsthetic was necessary. The comminuted fracture of the left wrist was reduced and set. X-ray pictures showed no fracture of the legs. With the aid of a few cubic centimeters of procain the tunica vaginalis cord and scrotal sac were thoroughly cleaned with a solution containing 2 per cent mercurochrome in 10 per cent acetone, and 50 per cent alcohol. The laceration in the scrotum was found to be a fairly clean cut through the skin and dartos about 4 centimeters in length. The tunica vaginalis was uninjured and there was no bleeding from it or the cord. After cleaning them and the scrotal sac thoroughly the testis and cord were replaced in the scrotum. The subcutaneous tissues were approximated with plain catgut interrupted sutures and a Dakin's tube inserted for drainage and irrigation. The skin was closed with fine black silk. There was no oedema or hæmorrhage following operation. For a period of 4 days a 1 per cent solution of mercurochrome was irrigated through the Dakin's tube twice a day. After this time the drainage tube was removed and the wound healed promptly and with an excellent result.

There remains still one case of traumatic dislocation of the testis which we came across in our search. This is a very peculiar one and a puzzle to us as to classification. It was reported by Jurinka in 1904 "Ein Luxation Testis, in the *Zentralblatt fuer Chirurgie*.

The patient was a man of 40 years who had been run over by a wagon. At the time of the accident the right testis disappeared and could be found nowhere although a very careful examination was made. An exploratory operation was carried out and still no sight of the lost member. As the surgeon was about to abandon the search the right thigh was rotated and suddenly quite unexpectedly the lost testis popped out of the right hip joint. This seems to us very fantastical and if it is true it is certainly the only case on record of a ball bearing hip joint (with apologies).

#### SUMMARY

Traumatic dislocation of the testis is far less common than cryptorchidism or aberrant migration of the gland. As in congenital ectopic testis, so in traumatic dislocation we have correspondingly similar types. The resultant location of the dislocated testis is dependent upon the force and direction of the blow, anatomical anomalies and the presence or absence of obstruction. There are three

groups of dislocated testis. First there is the superficial or subcutaneous dislocation. In this group we have the following types: superficial inguinal, pubic, penile, perineal and crural. Second, there is the internal group or those in which the testis passes within the external inguinal ring. In this group there are the inguinal, femoral, and abdominal types. Third, there is the compound dislocation of the testis in which it is extruded through a wound in the scrotal skin. In the literature, since the year 1800, we have found reports of 23 original cases of traumatic dislocation of the testis. The number of cases belonging to each type was: pubic, 6; superficial inguinal, 5; penile, 3; perineal, 2; in the inguinal canal, 3; and compound dislocation, 3. There are no authentic reports of a traumatic femoral, crural, or abdominal testis. We present in detail a new case of traumatic crural testis which we believe to be the first of its kind to be reported. There are only three cases of compound dislocation of the testis in the literature, though we feel that this must be a rather common industrial accident. We present a new case of this type also. The etiology, symptoms, physical signs, diagnosis, treatment and results in the cases belonging to each type have been discussed and our conclusions are that the diagnosis and treatment of this condition is usually relatively easy and the ultimate results excellent. The case histories have then been presented briefly of each of the 23 cases classified into the various anatomical types.

#### CONCLUSIONS

1. Cryptorchidism occurs in from 0.1 to 0.2 per cent of all young adults.
2. Aberrant migrations of the testis are less common than cryptorchidism. The perineal type is the most common over one hundred having been reported.
3. There are 13 cases of transverse ectopic testis in the literature.
4. A careful survey of the literature has brought to light only 23 original cases of traumatic dislocation of the testis. We add 2 more cases.
5. The resultant position of the dislocated testis is dependent upon 3 factors: (a)

anatomical abnormalities, (2) obstruction to dislocation in particular directions, and (3) the direction and force of the blow

6 There are three groups of cases the internal or those in which the testis passes through the external inguinal ring into the canal, the superficial or those in which it does not pass into the canal but lies subcutaneous, and the compound dislocation of the testis

7 In the first group are the femoral and inguinal canal and abdominal types

8 In the subcutaneous group we have five different types, pubic, superficial inguinal, penile perineal, and crural

9 The etiologic factor was, in the majority of cases, the passage of a wheel over the genital region

10 Symptoms were severe shock and local pain with nausea and vomiting

11 Diagnosis was usually very easy, after the traumatic swelling had disappeared Early diagnosis was often very difficult

12 In only two cases, both penile, was the epididymis torn from the testis

13 Treatment was very satisfactory, reduction without open operation was accomplished in only 3 cases, open reduction in 16 Six cases were not treated

14 All the cases were cured except one perineal testis which could not be held in its correct position and had to be removed

15 There were only 3 authentic cases reported in which the testis had been dislocated within the inguinal cord These were associated with some previous anatomical abnormality

16 There were no cases of traumatic femoral or abdominal testes on record

17 There were 6 cases of the pubic type, this being the most common Three were not treated and 3 were cured by open reduction

18 The superficial inguinal type comes next with 5 cases One case was not treated, all the others were cured by open reduction

19 There were 3 penile dislocations One was not treated and the two others cured by open operations

20 Only 2 cases of traumatic perineally dislocated testis were found One was not treated and the other necessitated orchidec-

tomy as it could not be retained in the scrotum This is the only patient in all the cases of dislocations not cured by operation

21 There is no authentic case of a true traumatic crural testis on record The new case reported here, we believe, is the first Open reduction was easily done and a cure obtained

22 Herniation, or as we have called it, compound dislocation of the testis, must be rather common although there are only 3 cases in the literature A new one is reported in detail

23 The prognosis in all these dislocations of the testis is excellent

I wish to thank Dr. Hugh H. Young for his many helpful suggestions in writing this paper

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SPINAL ANÆSTHESIA FOR THE HEAD, NECK, AND THORAX, ITS  
RELATION TO RESPIRATORY PARALYSIS<sup>1</sup>HARRY KOSTER, M D, F A C S, AND LOUIS P. KASMAN, M D, BROOKLYN NEW YORK  
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**A**LMOST every reference work on spinal anæsthesia mentions the danger of respiratory paralysis as a result of the action of the drug upon the medullary centers. The idea conveyed in most instances is that, because of diffusion, the drug ascends in the spinal canal from the point of injection (usually in the neighborhood of the second, third, or fourth lumbar vertebra, and if it reaches the medulla, depression of the respiratory center takes place to such an extent that paralysis ensues.

Various anæsthetic solutions of known specific gravity have been advocated as possessing special advantages in that the direction of diffusion could be limited and the medulla thus safeguarded from fatal depression. During the past 18 months, experience has taught us that it is advisable to induce (rather than to guard against) diffusion to the medulla and brain stem in order to secure anæsthesia of the entire body. During the past 4 years we have employed spinal anæsthesia routinely on all cases needing operations on structures below the diaphragm, and in the past year and a half its scope has been broadened to include all operations on structures above the diaphragm with the exception of those cases in which anæsthesia was required for a period so brief as to make it not worth while (for example, ambulatory cases needing incision and drainage of fingers, abscesses, etc.).

Before the adoption of our method of inducing head anæsthesia, experiments were undertaken to determine the safety or danger of the method. Particular interest was centered upon the effect of the anæsthetic agent on the medullary respiratory center. In our clinical studies of complete body anæsthesia (which now number over 750 cases) we have not met with serious respiratory or cardiac embarrassment. When such anæsthesia is induced, it is self evident that the anæsthetic solution affects the sensory roots at the upper portion of

the cord as well as the bulb. How else could anæsthesia be explained? Indeed, we can induce sleep by the same method and, where sleep results, the anæsthetic agent must of necessity have come into contact with the sensory cortex.

In an earlier paper in which one of us recounted experiences with spinal anæsthesia, some physiological evidence was presented to show that the anæsthetic agents did not have the effect upon the medulla which had previously been ascribed to them, and that, furthermore, there was a selective affinity for sensory nerves. In this paper more direct evidence will be presented.

## METHOD

Frogs were used. The cervical cord and medulla were exposed, the subarachnoid space was opened, respirations were noted, and then a cotton pledget dipped in a solution of neocaine (1/10 gram in 4 cubic centimeters of saline) was applied directly to the medulla and upper cervical cord. There was no apparent visible effect on the respiratory movements of the animal in spite of the fact that the proportion of the anæsthetic was much greater than that used in humans. The same experiment was tried with guinea pigs. The guinea pig was anæsthetized with ether, the upper cervical cord and medulla were exposed, the dura was incised, the subarachnoid space was opened, and the animal was allowed to come out of the anæsthesia. Pledgets of cotton soaked in neocaine solution were applied directly to the cord and medulla and the animal was kept in Trendelenburg position of 8 to 10 degrees for one half hour. During this time there was no visible effect upon the respiratory movements. At the expiration of one half hour the pledgets containing the anæsthetic solution were removed, the cord and medulla were washed with saline, and the wound was cleaned. There was no effect upon respiration but the

<sup>1</sup>Read at the 5th annual meeting of the American Society of Regional Anesthesia, April 8, 1929.



Fig 1

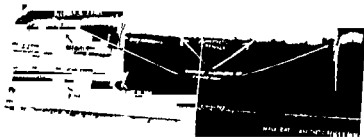


Fig 2

Fig 1 Semi-diagrammatic representation of the exposed upper cervical cord, medulla, and cerebellum of the cat with the subarachnoid space opened upon which a pledget of cotton soaked in neocaine solution (0.1 gram dissolved in 4 cubic centimeters of normal saline) is applied.

Fig 2 Record of respiratory movements obtained by sewing a thread into the ventral aspect of the lower portion of the chest wall of a cat upon whose exposed upper cervical cord and medulla a pledget of cotton soaked in neocaine solution (0.1 gram dissolved in 4 cubic centimeters of normal saline) has been applied.

animal died the following morning of meningitis no attempt having been made to maintain sterility. During the time the anæsthetic agent was applied to the cord and medulla, there was complete anæsthesia of the entire body as shown by failure to elicit response when the skin was pricked or cut. The animal appeared somnolent. The experiment was repeated in several guinea pigs with the same result, there being at no time any visible evidence of respiratory change. A similar application of anæsthetic solution was made in a cat (Fig 1). With the animal lying free on the operating table without a head holder, a tracing of respiratory movements was obtained by means of a thread, one end of which was sewed into the ventral aspect of the lower portion of the chest wall, the other end being connected to a lever which recorded on a smoked drum. At the expiration of 4 minutes a pledget of cotton soaked in the neocaine solution was supplied to the medulla and upper cervical cord and respiration recorded for the following 15 minutes. After the first few minutes, there were body movements made by the animal which gave wide excursions on the drum surface, but subsequently the animal remained quiet throughout the experiment. Before the solution of neocaine was applied, pricking the skin over any part of the body elicited a movement of the animal. One minute after the application of the neocaine, pricking the skin was not followed by any

response. Cutting the skin of any part of the body (including the head and neck) was not followed by a reaction. The application of the anæsthetic was continued for 15 minutes, the pledgets were then removed and the cord and medulla were washed with saline and covered with a sponge soaked in saline. For the next 30 minutes or 45 minutes from the time that the neocaine was first applied, pricking of the skin elicited no movements of the body. In other words, up to that time there was perfect anæsthesia. Forty five minutes after the application of the anæsthetic solution to the upper cervical cord and medulla and 30 minutes after the solution had been removed and washed away the anæsthesia began to disappear. This was made manifest by responses of the body and limbs to pricking. During all this time, however, there was no change in the respiratory movements nor was there any period of apnoea. A few minutes later the anæsthesia was apparently all gone because pricking of the skin elicited very active movements. This was true of all parts of the body (Fig 2).

#### SECOND GROUP OF EXPERIMENTS

The entire brain of a frog was destroyed, the spinal cord being left intact. The sciatic nerves were exposed in both thighs after the animal had recovered from the shock. At this stage pricking of any one of the extremities would elicit a response in the shape of a kick.



Fig. 3 Spinal frog with exposed sciatic nerves to one of which neocaine solution has already been applied

A pledget of cotton soaked in the neocaine solution was wrapped around the nerve for a distance of about 1 centimeter. In 3 minutes, the pinch reflex of that hind limb was abolished. The same thing was done to the other sciatic nerve and again in 3 minutes the reflex was abolished. An electric stimulus supplied by an induction coil, one dry cell of one and one half volts being used with the secondary coil directly over the primary, when applied to either hind limb, gave a slight local contraction of the muscle but no kick. When applied to the dorsal spine in the interscapular region, there was a forceful contraction and kick of both hind limbs. Stimulation of the sciatic nerve below the level of the application of the anæsthesia resulted in a kick of the same limb but not of the opposite. Stimulation above the level of the anæsthesia application gave a contraction of both hind limbs. To determine whether the complex reflex was due to electrical spread along the muscle and skin tissues or to nerve conduction the stimulus was changed from an electrical one to a mechanical one by the substitution of fuming nitric acid. Application to the hind legs of a small piece of filter paper soaked in 1 per cent nitric acid gave no response. Application to the inguinal region gave very forceful response from both hind limbs (Fig. 1).

Stimulation of the brachial plexus of one side by the induction current gave very forceful contractions of both lower extremities. These experiments were repeated in several frogs and the observations confirmed.

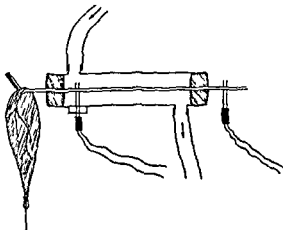


Fig. 4 The nerve of a nerve muscle preparation is passed through a glass tube which is made air tight by plugs of normal saline clay surrounding the nerve at the two ends of the tube. By means of two lateral tubules narcotic vapor is passed through the tube. The nerve is alternately stimulated by two electrodes. The inner testing the action of the drug on excitability while the outer shows the effect on the conducting power of the nerve within the chamber.

#### DISCUSSION

If the effect of the solution injected into the subarachnoid space upon the medulla is dependent upon the solution reaching the medulla by diffusion, the rate and degree of which cannot be controlled by the operator, the results cannot be as accurately studied as they can when the application of the anæsthetic agent is made directly to the medulla. Especially is this so since the effect of the anæsthetic upon the nerve tissue is quantitative. If paralysis of respiration results from the diffusion of the drug from the lower portion of the spinal subarachnoid space where it is injected (i.e. at the level of the second lumbar vertebra) to the medulla, the same effect, namely paralysis, should be produced more readily, more easily and more quickly by the direct application of the anæsthetic agent to the medulla. By such direct application there would not be any loss occasioned by diffusion, nor would there be a diminution in the concentration of the anæsthetic solution. The maximal effect, if the anæsthetic causes depression, should, therefore, be obtained. If, as some claim, diffusion from the lower portion of the spinal subarachnoid space is ordinarily so slight that the amount of anæsthetic



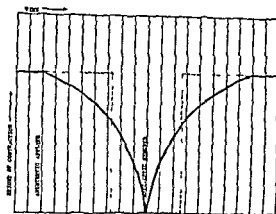


Fig. 5. Graph of outer electrode response showing effect on conductivity (interrupted line). Graph of inner electrode response showing effect on excitability (black line).

agent which reaches the medullary portion of the cerebrospinal system is insufficient to cause enough depression to result in respiratory paralysis and that only occasionally does the concentration of the diffused anæsthetic which reaches the medulla become great enough to induce respiratory depression and paralysis, then by the direct application of the concentrated solution one should *always* be able to induce such respiratory depression and paralysis.

In our experiments, direct application of concentrated solution to the medulla the relative *anæsthetic content* of which was proportionately far greater than that in the human did not result in any such respiratory depression or paralysis. It seems paradoxical that anæsthesia can be produced by the action of an anæsthetic agent on sensory fibers without producing an effect upon such a delicate mechanism as the respiratory center. Consideration, however, of the results obtained in our second group of experiments and also of our knowledge of the pharmacological action of the anæsthetics of the cocaine group presents an explanation for the apparent inconsistency.

In our experiments after the application of the cocaine solution to the sciatic nerve failure to get a pinch reflex of the corresponding hind limb meant that there had been an interruption in physiological continuity of the sensory nerve. In the same animal, when the

stimulus was applied to the dorsal spine in the interscapular region and there was a resultant forceful contraction and kick of the hind limb it became apparent there had been no interruption of conduction through the motor fibers of the sciatic. Quite apparently, then the anæsthetic agent had a selective affinity for sensory nerve tissue. With this in mind, it is not so difficult to understand how an anæsthetic solution which diffuses up to the medulla or at least up to the level of origin of the phrenic nerve, namely, the third fourth and fifth cervical nerve roots, could cause ablation of sensory conduction or could anæsthetize the sensory fibers without any effect whatsoever upon the motor fibers contained in that nerve or in the nerve tissue.

Santesson found that direct contact with a 5 per cent solution of cocaine hydrochloride broke sensory conduction so completely that the strongest possible tetanic stimulation peripheral to the anæsthetized area was no longer able to produce a response, while the same concentration of anæsthetic left motor conduction unchanged for about one hour. Alms found that he could interrupt sensory conductivity with a far greater dilution of anæsthetic than he could motor conductivity.

In studying various types of motor nerves in the vagus trunk above and below a cocaineized area, Dixon determined that centrifugal cardio-inhibitory fibers lose their conductivity while the centripetal reflexly acting respiratory and circulatory fibers retain their conductivity.

There are many other examples of the difference between the sensory and motor elements. Sensory nerve endings are poisoned by cocaine and not affected by curare. Motor endings are paralyzed by curare. Ammonia is a very strong stimulant to sensory endings in a wound, producing violent pain, but has scarcely any effect on motor endings. The partial selective affinity of the anæsthetics of the cocaine series for sensory nerves is only one expression of a general rule governing the reaction of sensory and motor fibers to other anæsthetics. Hitzig first demonstrated the disappearance of cerebral cortical sensibility long before the abolition of motor function. "Even when every trace of reflex has disap-

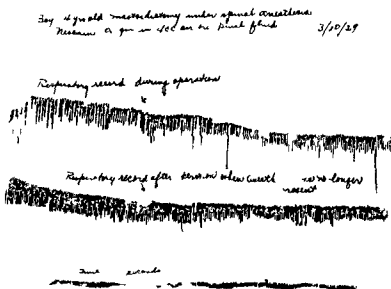


Fig. 6 Respiratory record in a male child 4 years old during and after a mastoidectomy under neocaine spinal anesthesia (neocaine 0.1 gram dissolved in 4 cubic centimeters cerebrospinal fluid) obtained by a pneumograph placed around the lower portion of the thorax. The upper tracing represents the respiratory excursion of the ribs during the anesthetic period while the operation was being performed and the lower is a record postanesthetic and postoperative breathing movement.

peared and when the most intense sensory stimulation, such as pulling on the dura, and strong induced currents applied to the mucous membranes of the nose produce reflexes no longer, certain cortical motor areas still respond to stimuli." Morphine, though administered intravenously, does not abolish cortical motor function, whereas it has a profound effect upon the cortical sensory area. Bernstein demonstrated the parallelism between the spinal cord and the cerebrum as regards the effect of chloroform and ether on the motor and sensory fibers. He blocked the circulation to the lower part of the cord and thus protected it from the chloroform circulating in the blood. The motor apparatus of the upper part although exposed to chloroform, still responded to impulses coming from the lower part of the cord, while the sensory mechanism in the poisoned section remained completely insensitive. It appears, therefore, that every where in the central nervous system the motor mechanism is particularly resistant to anesthetic action.

It is now not so difficult to understand how respiratory movements initiated by a purely automatic motor center may be maintained despite the existence of such a degree of poisoning by an anesthetic as has brought about an interruption of conductivity in sensory fibers. It is this property of selectivity (dependent upon inherent differences in nerve fiber, endings, and cells) which is so important a factor in the explanation of the phenomenon of surgical anesthesia of the entire body without respiratory paralysis. Thus, it becomes apparent that, in the average case of spinal anesthesia in which no fatality has resulted, the lack of respiratory paralysis is not due to any particular good fortune whereby there has been too little diffusion of the anesthetic toward the medulla in sufficient concentration to cause the dreaded effects but rather to the fact that the respiratory center is a station for the initiation of motor impulses and possesses, inherently, properties that render it immune to the effects of an anesthetic in the concentration advocated for spinal

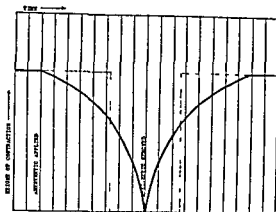


Fig 5 Graph of outer electrode response showing effect on conductivity (interrupted line) Graph of inner electrode response showing effect on excitability (black line)

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action The peripheral electrode through which a stimulus of the same intensity is sent evokes a response which continues without decrement even though the anæsthetic action proceeds Ultimately, however, when the response to the stimulation by the chamber electrode has diminished considerably in amplitude, but is still present, there is a sudden and complete cessation of response to stimulation by the peripheral electrode Continued application of the anæsthetic results in further gradual diminution in amplitude of response to stimulation by the chamber electrode until finally zero is reached Removal of the anæsthetic vapor from the chamber and continued stimulation at both points show an immediate and gradual return in amplitude of response on stimulation by the chamber electrode and a much later, sudden, and complete return of maximal response on stimulation by the peripheral electrode

This can be interpreted only as meaning that with the vapor acting on the nerve within the chamber, there is a gradual loss of irritability of the contained part of the nerve, whereas the unaffected portion of the nerve remains normally excitable As the anæsthetic continues its action and gradually diminishes the excitability of the contained portion, during which time the external portion of the nerve retains its excitability as is shown by maximal response, there is a sudden change in the nerve within the chamber which has the effect of preventing the impulse generated in the highly excitable nerve by the peripheral electrode from passing down to the muscle In other words, the conductivity is interrupted The interruption of conductivity always comes quite some time before the excitability is completely lost Applying this to the action of anæsthetic solutions on the medulla and upper cord, it can be seen that it is possible to have anæsthetic action to the point of interruption of sensory impulses in nerve fibers and yet be far from a complete depression of excitability of nerve cells Thus, sensory impulses enroute to the cerebrum may be stopped in the medulla because conductivity is interrupted, whereas the cardiac and respiratory nerve centers in the medulla, although their excitability is lowered, can still

initiate motor impulses in response to the physicochemical stimuli furnished by the blood This factor and the selective affinity of the cocaine group anæsthetics for sensory fibers explain the possibility of complete anæsthesia of the entire body without respiratory or cardiac failure

#### CLINICAL APPLICATION

These experimental facts have enabled us to employ spinal anæsthesia in every form and type of operative procedures encountered in an active surgical service The height of the anæsthesia is regulated by the amount of spinal fluid utilized for dissolving the drug The greater the amount of cerebrospinal fluid withdrawn, the greater will be the amount of diffusion and, therefore, the higher the level of anæsthesia This is in accordance with the well known physical law that the diffusion of liquids under pressure is inversely proportional to the pressure The diminution of the cerebrospinal fluid pressure caused by withdrawing a greater amount of liquid causes greater diffusion of the re injected fluid The details of the technique of inducing the anæsthesia have been thoroughly described in a previous paper

Every spinal tap and every injection of an anæsthetic solution is made in the interspace between the second and third lumbar vertebrae We have found that 1/10 gram of neocaine dissolved in approximately 4 cubic centimeters of cerebrospinal fluid (the amount necessary to fill one ampoule) is sufficient for the average operation below the diaphragm if completion can be expected within 50 minutes If anæsthesia of the thorax and head is desired, 250 milligrams of neocaine dissolved in 8 cubic centimeters of cerebrospinal fluid injected between the second and third lumbar vertebrae are used This method applies to adults and children above the age of 7 or 8 years Under that age the dose must be diminished proportionately Between the ages of 5 and 8, head anæsthesia can be obtained by means of 150 to 200 milligrams of neocaine dissolved in 6 cubic centimeters of fluid Between the ages of 2 and 5 similar anæsthesia may be obtained with 100 to 150 milligrams of neocaine dissolved in

**anesthesia** At this point it might be well to state that those who employ solutions heavier or lighter than cerebrospinal fluid in order to limit the height of anesthesia below the level of the medulla by controlling the degree of diffusion need no longer worry. Experimental and clinical evidence have clearly demonstrated that even were the solution to diffuse as they fear it might, a fatal termination due to respiratory paralysis would not follow.

It must be remembered that the action of the anesthetic agent on nerve tissue depends upon an affinity between it and the lipid substances in the nerve as well as upon a physicochemical solubility reaction occurring at a point of application. The anesthetic agent is very rapidly fixed by the lipid reaction. Lipoidal tissues have an affinity for anesthetics and unite with them with considerable avidity. It is therefore, difficult to understand how solutions, even of a specific gravity differing from that of the cerebrospinal fluid, can be made to diffuse upward or downward by the tilting of the table 5 or 10 or more degrees some time after the fluid has come in contact with the nerve tissue. The anesthetic substances in solution are very rapidly fixed by the nerve tissue with which they come in contact. Thereafter, as far as diffusion is concerned, it matters not how the position of the patient be changed. There are other reasons for altering the position in spinal anesthesia. In support of this idea is the evidence that in the animal to whose exposed medulla an anesthetic solution has been applied for 15 minutes the thorough washing off of the excess of anesthetic with saline solution does not result in a disappearance of the anesthesia. The latter persists for an additional 30 minutes (Fig. 2).

Complete anesthesia of the entire body (including the head and neck) developed in the animals in which the anesthetic was applied to the medulla and upper cervical cord. They also became somnolent. This means that not only was there an interruption of conduction along the sensory fibers of the upper cervical and cranial nerves but also diffusion toward the cortex was secured in sufficient concentration to produce sleep. This idea is confirmed by clinical observations.

In many patients, particularly in children, where head anesthesia is induced by encouraging diffusion of the drug upward toward the medulla it is found that sleep results. This can be explained only by assuming that the anesthetic causes a depression of the activity of the cerebral cortex. Thus, not only is it safe to allow and expect upward diffusion of an anesthetic agent introduced at the level of the second or third lumbar vertebra, since this diffusion is bound to diminish the concentration of the drug to a point far below any possible dangerous action but also it is safe to apply this anesthetic solution directly to the medulla and upper cervical cord in a concentration much greater than it could ever attain by upward diffusion. That there is some effect upon respiration seems likely, inasmuch as the automaticity of the centers is to some extent controlled by afferent impulses transmitted through the vagi or from other sections of the brain. The temporary ablation of these impulses however, can in no way seriously affect the organism. The center has sufficient inherent automaticity of its own dependent upon and regulated by the metabolic activity of its constituent parts, controlled by the reception of physicochemical stimuli supplied by the blood.

There is another factor which, possibly may contribute to the phenomenon of the interruption of sensory activity without the abolition of the development and propagation of motor impulses from the respiratory center. Nerve fiber possesses two distinct properties namely, excitability and conductivity.

That these properties are separable has long been known. If part of the nerve of a frog gastrocnemius sciadicus preparation be enclosed in a chamber into which anesthetic vapor can be introduced and the nerve stimulated by two electrodes (Fig. 4), one within the chamber and the other peripheral to the chamber, and the muscular responses charted a graph such as is shown in Figure 5 will be obtained. It is seen that the responses from the muscle on stimulation by the chamber electrode begin to diminish in amount as soon as the vapor comes in contact with the nerve and this diminution increases by a definite decrement as the anesthetic continues its

ing a hæmolyzing effect on the blood and causing irritation of the kidneys and bronchial pulmonary tree, there is eliminated what would otherwise be a much greater operative tissue insult.

Spinal anæsthesia is the most suitable form of anæsthesia in operative procedures for the treatment of osteomyelitis. The shocking impulses attendant upon bone trauma by the chisel and mallet are short circuited. The deleterious effect of profuse hæmorrhage is diminished by the relative anæmia occasioned by the "splanchnic phlebotomy." The abolition of the cough reflex by profound inhalation anæsthesia is unquestionably a factor in the production of aspiration pulmonary complications. The elimination of such complications of inhalation anæsthesia is accomplished by root block. Surgery in metabolic diseases such as diabetes, nephrosis, exophthalmic goiter, and particularly in those diseases associated with acute toxæmias, as eclampsia and emesis gravidarum, should be done only under root block to avoid many of the unpleasant and dangerous features of the inhalation anæsthetics already mentioned. Surgery of the deeper tissues of the neck which involves some traumatism to the trachea is bound to be complicated by the irritating effect of inhalation narcotics upon the tracheal mucosa. In this type of case, spinal block is also particularly indicated. Although the school of surgeons who use inhalation narcosis in surgery of the thyroid (especially in exophthalmic goiter) has a large number of followers who claim that local anæsthesia has very little if any advantage over inhalation narcosis in this particular field, it would seem as though there could be very little doubt that spinal block supersedes both inhalation narcosis and local anæsthesia. There is no distortion locally of the tissues as there is with infiltration, there is not the increased tendency toward acidæmia which invariably accompanies inhalation narcosis, the avoidance of irritation to the mucosa of the tracheobronchial tree has already been mentioned, shocking impulses from the operative field are all interrupted. Indeed, if there be any site above the diaphragm where there is need of an ideal form of anæsthesia it is with this type of

surgery. The requirements are met by spinal anæsthesia.

Inhalation anæsthetics are best given to patients who have been properly prepared. Such anæsthetics administered without adequate preparation in emergency surgery (for example, after a full meal) complicate operative procedures and may be productive of grave postoperative sequelæ. Emergency surgery may be performed under root block without these drawbacks. This is particularly true in emergencies such as those complicated by concomitant pulmonary infection.

In our clinical studies on humans of the effect of spinal anæsthesia on the respiratory movements, we find results which are comparable to those obtained in the cat. If respiratory movements are recorded on a drum by means of a tambour connected to a kymograph, it is seen that the downward movements which correspond to inspiration and the upward movements which correspond to expiration are both followed by a slight expiratory pause. Similar records in patients who have been subjected to spinal anæsthesia show no change except a slight diminution in the amplitude of the excursion and also an increase in the length of the expiratory pause. This is true not only of cases in which anæsthesia reaches a level of the diaphragm or the nipple line but also in cases in which head anæsthesia had been induced. Figure 6 shows the respiratory curve taken by means of a pneumograph from a child who was operated upon for mastoiditis under spinal anæsthesia. A comparison of the pre operative and operative respiratory excursions shows a diminution in amplitude of movement and an increase in the length of the expiratory pause. In spite of the fact that there was anæsthesia of the sensory nerve to the face and head which means that the anæsthetic must have reached the level of the upper portion of the medulla, there was no respiratory paralysis. As has been stated in many texts and as would perhaps be expected if the pharmacological fact were ignored, there should at least be a paralysis of the intercostal muscles, the muscles which raise the ribs during inspiration. However, these graphs which were taken by means of a pneumograph placed around the chest wall

4 cubic centimeters of fluid, and below the age of 2 head anesthesia can be obtained with from 5/100 to 1/10 of a gram dissolved in 3 cubic centimeters of cerebrospinal fluid. This form of anesthesia fulfills all the requirements of an ideal anesthetic as no other method does. The desiderata of the satisfactory anesthetic are safety, universal applicability, maximal relaxation, blandness in the sense that tissue irritation is not produced, ease of administration, and freedom from shock. In the past 4½ years, we have used spinal anesthesia routinely. We have never come across any cases in which we found its use contra indicated except in cerebellar neoplasms and diseases of suppurative nature of the spinal column or of the overlying tissues at the site or in the neighborhood of the injection point. The advantages of this form of anesthesia over any other form in abdominal operations and in fracture work have been thoroughly discussed elsewhere (6). In thoracic operations, it is especially indicated because of the relaxation and the calm respiratory excursion which accompanies its use. In empyema it is of considerable value. With local anesthesia, a rib may be resected with facility but almost always, when the cavity is opened to drain off the pus, no matter how slowly the latter is allowed to escape, there is a very distressing and sometimes dangerous dyspnoic period. This is avoided entirely when spinal block anesthesia is used.

An interesting phenomenon in head anesthesia is the absence of complete motor paralysis of the upper extremities and head. This is frequently of considerable value, as for example, in the repair of lacerated tendons of the hand or fingers. It is of considerable advantage to be able to test out the action of the tendon by attempts to secure voluntary motion. This, of course, is not possible under any form of inhalation narcosis.

The advantages that have been voiced for spinal anesthesia over ether anesthesia in abdominal and lower extremity operations hold also for operation on the upper extremities, thorax, and head. Except for the local trauma of the needle during introduction, there is no tissue irritation. This is in marked contrast to the effect of ether on the respira-

tory mucosa. Anyone who can do a lumbar puncture can induce spinal anesthesia. The method is reasonably "fool proof." But very few movements are necessary. No situation where individual judgment is required ever arises after administration. The only time where judgment is called into play is in varying the dosage according to the age of the patient. Spinal anesthesia effectively prevents operative shock. The blockade of shocking impulses coming from the operative field has a very beneficial influence on the central nervous system and is at least as efficacious in producing the anociassociation of Crile as is local injection. It has very definite value in operative procedures in patients having advanced cardiac disease. Here, particularly with failing compensation, greater strain is placed upon the right side of the heart. The induction of anesthesia is accompanied by an effect comparable to that of phlebotomy, the drainage of blood into the abdominal veins. The fall in pressure rests the heart, and its burden is considerably lightened throughout the duration of the anesthetic. In advanced pulmonary diseases complete freedom from pain can be readily produced without dangerous irritation to the mucosa of the tracheobronchial tree common to inhalation anesthetics. In the late stages of renal disease it is highly essential to minimize anesthetic irritation of the kidneys. All forms of inhalation narcosis are more irritating than is spinal anesthesia. This is especially noticeable in older individuals. It is also particularly true of alcoholics. The latter not only require much greater amounts of inhalation anesthetic but usually have associated renal involvement. Such patients give far fewer premonitory symptoms of impending disaster with inhalation narcosis than does the average case. For this reason, also, spinal block is indicated. Patients having hypertension may be operated upon to advantage under spinal block. Ether and nitrous-oxide raise the general blood pressure and are, therefore, not well borne by hypertension cases. In the aged anæmic or cachectic patient needing surgery the problem of anesthesia is ideally solved by spinal block. By the substitution of spinal block for inhalation narcosis, the latter exert

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and which represent the amplitude of excursion of the ribs and not of the diaphragm are evidence of the fact that the respiratory muscles and their innervation are *not* interfered with by an anæsthetic which reaches the level of the upper portion of the medulla and which, all along the pathway of diffusion affects sensory roots springing from the spinal cord and brain stem.

The literature on spinal anæsthesia contains many references to blood pressure changes. We have kept careful records of blood pressure variations in several thousand cases and have arrived at the conclusion that it is impossible to predict in any case with any degree of accuracy what will happen to the pressure after the injection of the anæsthetic solution. In some instances there is no appreciable change. Other patients show a maximal fall of about 10 millimeters of mercury. A fairly large number have a drop in pressure of between 20 and 30 millimeters within 10 minutes after the time of injection, this fall being sustained for approximately three-quarters of an hour, the return to normal immediately preceding the return of sensation. In some instances the drop is from 50 to 75 millimeters within 10 minutes, and within another 10 minutes there is a return to about 20 millimeters below the normal. In at least 5 per cent of all cases the pressure drops within 10 minutes to such a level that no radial pulse can be felt nor can the pressure be registered by the manometer. At first this manifestation was quite alarming and all types of stimulation were resorted to. Intravenous administration of adrenalin, caffeine, strychnine, etc. were all tried. The effect of these drugs, however, if any, is transitory. It was soon noticed that even without the use of drugs the pressure returns to a higher level within a very short period (approximately 10 minutes) if the Trendelenburg position is maintained. Should this state of affairs occur during an intra abdominal operation, the operator can readily reassure himself regarding the condition of the patient by palpating the abdominal aorta in which slow, regular pulsations can be distinguished. However, should such an exploration not be possible, the uninitiated surgeon might easily

become alarmed. It is no exaggeration to state that in over 250 cases out of our total series (4,500) the anæsthetist (whose only duties during the anæsthetic period is to record the blood pressure and respiration during the entire operative procedure) notified us that it was impossible to secure a blood pressure reading by means of the manometer. Of late, when we receive such information, nothing is advised. Our experience has taught us that, ultimately, the pressure will return and no untoward effect be occasioned as long as the patient remains in the Trendelenburg position.

The physiological reasons for the fall in pressure—the details of which are given elsewhere (6), in brief, are as follows:

The nerve control of the blood vessels is regulated by two antagonistic sets of fibers, one, constrictor, and the other, dilator. The vasoconstrictor fibers leave the spinal cord by way of the anterior roots of the spinal nerves from the first dorsal to the third or fourth lumbar nerve, inclusive, to go by way of the white rami communicantes to sympathetic ganglia. The major portion of the fibers forming the white rami from the lower seven dorsal and upper two or three lumbar roots unite to form the splanchnic nerve. The upper two or three lumbar roots often take a separate course and are referred to as the lesser splanchnic. The greater splanchnic nerve supplies all the blood vessels of the abdominal viscera with constrictor fibers. Section of this nerve causes a tremendous fall in the general blood pressure because of the great dilatation of all the blood vessels in the abdominal cavity. The dilatation may be so extensive that the splanchnic vessels may contain all the blood of the body. In spinal anæsthesia which is essentially a block anæsthesia, there is an interruption of the impulses passing through the roots. Among other intercepted impulses are those which supply vasoconstrictor stimuli to the vessels. The failure of the vasomotor constrictor impulses to reach their destination results in a marked relaxation of the vessels. Since this type of anæsthesia affects some if not all the lower dorsal roots, many splanchnic constrictor impulses are interrupted. The number of roots affected

determines the amount of fall in blood pressure. If all the roots supplying the constrictor fibers to the abdominal blood vessels are involved, the fall in blood pressure resulting from the tremendous relaxation of these abdominal vessels may be so great that no manometric estimation can be made. When this occurs, there is no sign, whatsoever of cardiac failure. Although the contractions of the heart are forceful their output rapidly decreases, the zero point being approached in time due to a diminution of the quantity of venous blood brought to the right ventricle. The principle factor maintaining venous flow is the *vis a tergo* produced by the ventricular contraction on a closed system of vessels possessing elastic walls in which a definite degree of tonicity must be maintained by constrictor impulses. With a marked dilatation of the blood vessels within the abdominal cavity and the consequent tremendous fall in blood pressure the venous return flow to the heart becomes so inadequate that not enough blood can be pumped out to the brain. The latter however must always secure a normal amount of blood. Failure to supply the blood to the brain in sufficient quantity results in a bulbar and cerebral anæmia which is responsible for death in spinal anæsthesia. The fault is not due to failure of the myocardium. Nor is the fatality occasioned by primary respiratory paralysis. When respiratory paralysis ensues it is consequent to the cerebral anæmia resulting from failure of the veins to supply sufficient blood to the cardiac chambers to allow the active heart to pump enough to the brain. The condition is comparable to that of an internal hæmorrhage the bleeding being into the relaxed vessels of the abdominal cavity in which the venous pressure is nil and from which no blood is being returned to the heart. Such a state of affairs can be counteracted in only one way and that is by the utilization of the Trendelenburg position. This insures sufficient gravity drainage from the veins to the heart whence enough blood is quickly relayed to the brain by the body's active and competent pump. Thus is a fatal cerebral anæmia forestalled. Our experience in many cases in which there was no recordable

brachial artery pressure for a considerable period of time has convinced us that with the patient in Trendelenburg position there is no danger from spinal anæsthesia, irrespective of the amount of blood pressure fall. It is for this reason, also, that we feel, despite the citations to the contrary with which the literature on spinal anæsthesia is replete, that hypotension is in no sense a contra indication to the use of this form of anæsthesia. We have operated upon many patients with ruptured tubal pregnancies in whom, in spite of treatment for shock and hæmorrhage, the pressure did not rise above 55 millimeters of mercury, with perfect equanimity regarding the effect of the anæsthetic and we have had no reason to change our opinion.

Regarding the marked variations in pressure fall following the application of the anæsthetic to the spinal nerve roots, it might be mentioned in explanation that separating the motor from the sensory roots in the spinal canal is the *ligamentum denticulatum*, an irregular cribriform membrane. This separates the canal into an anterior and posterior compartment. When the anæsthetic solution is introduced into the subarachnoid space, it usually enters the posterior compartment and diffusion into the anterior compartment, in which lie the anterior roots containing the vasomotor constrictor fibers, is dependent to a certain extent upon the number and arrangement of the perforations in the separating ligament. Only near the site of puncture is the anterior diffusion great enough to affect thoroughly the anterior roots and their contained vasomotor fibers. When the needle penetrates the *ligamentum subflavum* and enters the posterior compartment of the subarachnoid space, if it is pushed farther, it separates the nerve bundles forming the *cauda equina* and may enter the anterior compartment. Should this occur if the anæsthetic fluid is now injected more anterior roots will be affected and more vaso constrictor impulses will be blocked so that the pressure fall will be greater. It becomes evident, then that the partial control of the blood pressure fall depends upon injecting the anæsthetic fluid into the posterior compartment of the subarachnoid space.

As to vasomotor stimulants it might be mentioned here that we consider them of little aid. Those drugs, the action of which depends upon their effects on the vasomotor centers, are, of course of little value. Impulses emanating from these centers could not pass the blockade. The only drugs which might have any value are those which act directly upon the blood vessels, and even here we are confronted by a condition in which it is almost impossible to get enough of the drug to the desired region to secure any worth while effect. If adrenalin be given intravenously in a normal animal, the vessels (particularly of the internal vascular area) respond to its constrictor action with a marked rise in blood pressure. Plethysmographic investigation reveals that the kidney and spleen decrease considerably in volume so that the curves taken from these organs move in a direction opposite to those of the blood pressure. The blood pumped out of the internal organs is forced toward the heart. The rise of blood pressure which follows the intravenous administration does not as a rule last longer than from 1 to 3 minutes because of the very rapid destruction of the adrenalin due to the fact that oxidation takes place in the alkaline solutions of the body tissues. Adrenalin has a direct action on the heart, increasing the rate and strength of systole. This effect corresponds to the stimulation of the accelerator nerve. This too is quite transitory. When adrenalin is injected into an individual or an animal in whom spinal anesthesia has been induced the effect must necessarily be different, and unfortunately the greater the need of the effect the less is the desired result. The marked fall in blood pressure in such a person or experimental animal resulting in venous stasis prevents the adrenalin from reaching the desired point where its action is most needed, namely, the dilated splanchnic vessels. Too small a quantity is carried to this area to secure any valuable local reaction.

It was the realization of this state of affairs which probably prompted Babcock to advocate the intravenous saline injection in cases of severe collapse following spinal anesthesia induced by the method he employed. The injection of saline solution under gravity pres-

sure into the veins insures liquid contents for the heart chambers upon which the cardiac muscle can contract and which can be sent out into the circulation to help maintain the activity of the center.

With this form of anesthesia the most frequent complication encountered is postoperative headache which occurs in about 10 per cent of the cases. In most of these the headache is very mild and is not appreciated until the patient attempts to sit up when it varies from slight dizziness to slight pain. Occasionally, the headache is quite severe and the patient is very uncomfortable. The application of the magnesium sulphate enema method for lowering the cerebrospinal pressure used in head injury cases immediately controls the headache in almost all instances. Six ounces of 50 per cent solution of magnesium sulphate every 4 hours in enema form is the method employed. One patient who did not respond completely to this method yielded to a spinal puncture through which 40 cubic centimeters of fluid were removed from the canal. Other complications such as two cases of diplopia, one case of parasthesia of the buttocks and anal region, and one case in which there was some atrophy of the extensors of the left leg are discussed in detail elsewhere (6).

Postoperative urinary retention is not an infrequent complication which may be accompanied by constipation. The knee jerks are exaggerated in these cases. The condition is usually cleared up after one or two catheterizations. Rarely does it persist for more than 4 or 5 days. It must be remembered that most of these complications are phenomena that have been recorded after simple lumbar puncture. The greater the amount of fluid removed, the more likely will symptoms develop. It is characteristic of these symptoms that while the patient is in the horizontal position they usually lessen or disappear entirely, whereas with every attempt to gain the sitting or erect posture they are markedly aggravated. An explanation has been advanced that the orifice made in the subarachnoid space by the needle often fails to close for some time after its withdrawal and allows continual oozing through the puncture. The loss of

fluid in this way in itself probably has no effect in the production of symptoms which are most likely the result of some degree of irritation to the meninges. Even slight extravasations of blood may cause serous meningitis which in turn results in increased fluid production and consequent symptoms.

In a study of the effect of blood in the cerebrospinal fluid, Bagley recently showed that as soon as blood is liberated and mixes with the cerebrospinal fluid there is some irritation of the meninges probably comparable to the chemical peritonitis which is induced in the peritoneum when free blood escapes. In all likelihood this plays an important role in the production of headache as the result of lumbar tap. We have had no experience with the treatment of this form of headache by the injection of small quantities of air into the subarachnoid space.

In a very small number (not more than four) of intractable cases which did not respond to the magnesium sulphate treatment we have had occasion to do a spinal puncture and allow the escape of from 10 to 15 cubic centimeters of cerebrospinal fluid. This procedure always resulted in a cure.

It is understood that the attitude toward spinal anæsthesia discussed in this paper may be considered quite revolutionary, but a careful review of the literature will satisfy one that this method not only is not a new one but also that it has been employed in thousands of cases by men like Jonnesco, Leflatrie, and many others. In this country there are references to the use of spinal anæsthesia for head operations back as far as 1901 in which year mastoidectomies and enucleations of the eye were reported (Payne). Among the reasons for the method having been placed in the discard in all likelihood was the adverse criticism based purely upon theoretical speculations and not upon the accumulation of scientific data.

Not knowing anything regarding the selective affinity of the cocaine anæsthetic group for sensory nerves, how easy it would be to imagine that the effects of diffusion of the anæsthetic solution within the spinal subarachnoid space up to the higher levels of the cord and the medulla would produce a fatal respiratory and cardiac paralysis. One could

not avoid reaching an erroneous conclusion as a result of logical reasoning based upon false premises, which is exactly what has happened. Throughout the country the number of fatalities reported as a result of the use of spinal anæsthesia without observing the precautions necessary to avoid a cerebral anemia (which is really responsible for the fatality) has done much to delay the progress and the more universal acceptance of spinal anæsthesia as an anesthetic.

The experience of the authors with head anæsthesia over a fairly large number of cases has convinced them not only that the method is safe but that it is universally applicable. In all fairness it must be mentioned here that the anæsthesia has not been perfect in all cases. There have been instances where the patient has complained of painful sensations. This is attributed to inexperience on the authors' part because it is believed greater familiarity and a larger series of cases will so modify the dosage and the amount of fluid extracted from the cerebrospinal system as to enable complete and accurate control of the amount of diffusion of the drug and the amount of concentration of the drug at any desired level. In this connection it must be remembered that the spinal subarachnoid space is divided into two compartments, an anterior and posterior, by the ligamentum denticulatum which contains many apertures. If the needle which is introduced into the spinal subarachnoid space is pushed through between the fibers which form the cauda equina so that it reaches the anterior compartment, there will be greater diffusion along the anterior compartment than there will be along the posterior compartment. This will modify the amount of drug reaching the upper cervical cord and medulla. Variation in the position of the needle point in the spinal subarachnoid space is in all likelihood responsible for the few cases in which there has been failure to get complete and satisfactory anæsthesia. It is believed however, that here too, greater familiarity with the method will result in complete control of the anæsthesia.

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## UNUSUAL BONY INJURIES ABOUT THE HIP JOINT<sup>1</sup>

HFRMAN F JOHNSON M D OMAHA NEBRASKA

**I**NJURIES to the osseous structures in and about the hip joint are either common or rare depending upon the age period in which they occur. Some conditions, however are uncommon at any period and offer difficulty in diagnosis even with the roentgen ray. Key points out that contusion to the joint is uncommon due to the deep seated position of the joint and the accurate coaptation of the joint surfaces, while the strength of the muscles and ligaments about it gives adequate protection against sprain.

### CERVICAL FRACTURE

Fracture of the neck of the femur is without question the most frequent lesion found but is limited to the period from 50 years upward. In the period between 20 and 40 years fracture of this type is very infrequent because the strength of the neck is greater than that of the shaft, and the latter therefore gives way first.

We have now under treatment a young man of 34 years who sustained a transcervical fracture of the femur when he fell from a second story window. The signs were typical of a neck fracture but on account of his age, clinical diagnosis was withheld until examination was made with the roentgen ray.

The Whitman abduction treatment, as followed out in this case and illustrated, is our method of choice in the uncomplicated cases irrespective of age (Fig 1).

In children and adolescents traumatic epiphyseal separation, as well as the type of coxa vara acquired gradually in patients over weight, is the condition most frequently manifested and should be definitely differentiated from actual fracture, as it often occurs with-

out immediate complete disability and if not corrected early, is followed by limitation of motion and slight shortening (Fig 2).

### DISLOCATION

Traumatic dislocation of the hip is generally regarded as a relatively frequent occurrence but constitutes only about 2 per cent of all dislocations and is limited to the period considered as the prime of life. In this period however, fractures of the shaft are much more common than are dislocations. The dorsal dislocation is the usual type encountered and roentgen ray examination in these frequently reveals fragments of bone torn away from the rim of the acetabulum by the strong ligaments or broken off by the impact of the dislocating head. Occasionally the entire superior rim of the acetabulum may be carried upward by the head, as in the case coming under our observation. At attempted reduction, the fragment of rim entered the acetabulum in advance of the head and thus rendered reduction of the dislocation impossible except by open operation. Open reduction was performed and, after the rim was lifted from the acetabulum the head of the femur was easily skidded into the cavity. The fragment was then fixed in its proper position by a temporary steel drill driven through it and into the ilium. One end of this drill extended out through the wound and was easily removed after 3 weeks.

Very rarely there is a fracture of the head of the femur associated with dislocation, an entity which will be discussed under a separate heading. Bigelow in his classical article on dislocation of the hip does not mention a co-

ciated fractures, as the roentgen ray was then unknown and these complicating factors could not be recognized clinically due to the deep seated position of the joint

The unusual feature of traumatic dislocation is its rarity in children. Moffet, in reviewing 1,842 dislocations, found only 3 in young individuals, 2 patients being under 10 years and the other, 14 years of age. In the literature only 49 cases were found by him. Choyce, in 1924, reported 6 cases from the University College Hospital, London, and analyzed 53 from the literature. He points out the relationship of Legg Perthes disease to this trauma which occurred in 2 cases while a third developed rarefaction of the femoral neck with pathological dislocation. These complicating conditions occurred about 1 year after injury and were considered due to loss of the vascular supply by way of the ligamentum teres. This, in my opinion, warrants plaster fixation following dislocation as brought out farther on in this paper.

We have the opportunity here of presenting two additional cases, one being a posterior dislocation in a boy of 9 years with no evidence of epiphyseal injury. The mechanism of the injury in this patient was quite characteristic for dislocation. He was struck on the flexed knee with the thigh also flexed on the trunk and the direction of the force paralleling the shaft of the femur. Reduction was accomplished with little difficulty and after a period of plaster immobilization for 1 month he had almost full range of motion and no limp (Fig 3).

The second patient was a boy of 4 years who 17 days previous to admission to the University Hospital had slipped and fell so that he was completely disabled. His pain was then localized in the left knee region which was placed in a plaster cast. Disability continued so he was sent in for diagnosis. On examination a clinical diagnosis of dislocation of the hip was made on the findings of thigh flexion, internal rotation, and prominence of the greater trochanter which was well above Rose Nelaton's line. The misleading knee pain at the time of injury undoubtedly was referred pain as occurs in inflammatory lesions of the hip. Another unusual finding was the

rather free mobility of the head of the femur at the time of our examination, the usual complete fixation of traumatic dislocation not being present (Fig 4). Reduction was not difficult and immobilization consisted of a hip spica cast for 1 month. Examination 4 months after injury was negative, however, we will keep this boy under observation for at least 1 year in order to avoid any complications as observed by Choyce.

In the review of his cases, Moffet considered that the failure in reduction is usually due to ineffective application of traction preliminary to manipulation. He insists on the application of a carefully molded cast following reduction. In the old cases, he recommends open reduction without an attempt at closed manipulation as the latter procedure is uniformly unsuccessful. Our personal experience confirms Moffet's opinion as to preliminary traction as well as plaster immobilization after reduction. The latter is obviously indicated where fracture of the rim of the acetabulum has occurred, in order that union may take place with a minimal traumatic arthritis. The Bigelow method of reduction needs only passing mention as all are familiar with the procedure. In his own words "Flexion lies at the foundation of success in the reduction of femoral dislocation, and compared with this the rest of the manipulation is of secondary importance." The various modifications adopted in reducing dislocations have the same underlying principles. The avoidance of additional trauma by unnecessary roughness in the manipulation has been stressed by Denue in his method and carried out by us both in the congenital and traumatic cases. The thigh is first flexed sharply on the trunk and rotated inward. The knee is carried over the abdomen well to the opposite side and with one hand controlling it and pushing in the longitudinal axis of the thigh, the other hand guides the head as it descends posterior and inferior to the acetabulum. The knee is then carried across the body to its own side and downward to the surface of the table. As the extremity is brought down from its position of flexion, abduction, and outward rotation toward the anatomical position, the head slips into the acetabulum with a decided jump. The diffi-

culty encountered in some instances has been that the head was forced too low by the pushing maneuver and carried into the antero-inferior region with the subsequent abduction. Needless to say complete relaxation by general anesthesia is essential for this procedure, although Dshanelidze states that he reduces all dislocations without anesthesia or assistance.

#### CASE REPORT

**CASE 1** A farmer of 34 years was thrown from a vehicle in a runaway sustaining injuries to the right upper and lower extremities with complete disability. When examined 48 hours later his right lower limb was in the position of semiflexion, adduction and internal rotation. The greater trochanter was quite prominent and high. Roentgen ray confirmed the diagnosis of dorsal dislocation of the femur and revealed in addition a fracture of the upper rim of the acetabulum. Reduction was obtained by the procedures as outlined in detail above and the check up X ray examination disclosed that even the displaced fracture of the rim had returned to its proper position. A hip spica cast was worn for 6 weeks, and he returned to work as a rural mail carrier 10 weeks after the injury. Six months later a follow up letter informed us that he was entirely symptom free (Fig. 5).

**CASE 2** A very similar type of injury was sustained by another man 53 years of age. One would think first of a fractured neck of femur at this age rather than dislocation. It proved however to be the latter and reduction was easily accomplished 6 hours after the injury. In spite of 8 weeks immobilization weight bearing was painful for over a year although range of motion was practically complete. His age undoubtedly accounted for the persistent although decreasing irritation of the joint.

Anterior dislocation of the hip is quite rare and the mechanism of injury is that of extreme abduction. The usual deformity is slight flexion, abduction, and external rotation, the latter is increased in the pubic type of dislocation and the head can be readily palpated. In obturator dislocation the signs are less positive. An outstanding clinical sign in all dislocations is the absolute fixation of the extremity and this is important in differentiating the lesion from that of fracture.

Reduction of this dislocation is usually accomplished by flexion and abduction as the first step. In this position the thigh is rotated inward then adducted and extended. During the entire maneuver considerable traction should be employed. In old anterior dislocations Watkins summarizes the hindrance

to reposition as due to (1) constriction about the femoral head by the torn capsule, (2) the formation on an adventitious capsule, and (3) contracture of the fascia lata and gluteus medius. He reports a case of 3 months' standing in which open reduction was performed successfully, the capsule being opened and the fascia lata divided.

#### ACETABULAR FRACTURES

*Central fracture of the acetabulum with or without central dislocation of the head is an unusual and difficult fracture problem. This lesion is limited to the middle age period although a few cases have been reported in children and the author's patient, a boy of 11 years, discussed in detail elsewhere makes it seem probable that separation of the fragments of acetabulum along the lines of embryonal origin as suggested by Vaughn is not as uncommon as considered, for the roentgen ray does not give us accurate evidence if the separation is only slight, as in my case. However, here the necropsy examination revealed a separation three sixteenths of an inch wide at the epiphyseal line between the os pubis and ischium. Kreuscher found no case reported under 18 years of age. His patient a girl of 12 years, was thrown to the sidewalk when struck by a car, alighting squarely on the greater trochanter. She was treated 3 days for a sprain before positive diagnosis was made. An interesting complication was the development, 8 months after recovery, of a destructive lesion in the region of the epiphysis. A four plus Wassermann was found and with antiluetic treatment and rest the local condition cleared up entirely.*

*If the trauma is marked enough to produce wide separation, the head is permitted to pass through the aperture and thus we have the central dislocation. If this luxation is marked, the fragments of the acetabulum may close together, grasping the neck so that closed reduction becomes impossible. In Vaughn's case this proved to be the complicating factor which made reduction very difficult even when a lever was passed through the acetabulum over the head and the latter pried back from its locked position. Kleinberg mentions the rarity of the condition and reports 3 cases all*

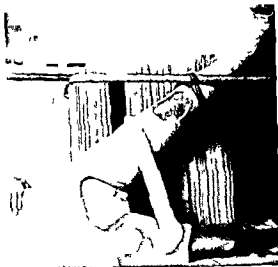


Fig 1 Abduction cast for transcervical fracture of left femur

in the thirties. He stresses the importance of determining injuries to bladder, blood vessels or other important pelvic structures. Vaughn in reviewing the literature, finds 26 cases positively this type of lesion and 33 doubtful.

The mechanism of the injury is very characteristic. A fall of considerable severity, the patient striking on the greater trochanter has constantly been the type of injury sustained. Crushing injuries of the pelvis may produce fractures which extend into the acetabulum as in a case of the author with a fracture of os pubis which coursed obliquely into the joint.

Considering the number of these cases seen late, the diagnosis is far from simple. Whitman, who reports 6 cases, states as there are no evident signs of fracture the injury often passes as a contusion. He cites a case of suspected pelvic tumor which at operation proved to be the head of the femur in the pelvis.

The clinical findings in this condition as noted by most observers and as found in our patient is that of slight flexion, adduction and internal rotation. Boorstein points out that with this deformity the head is driven backward and inward toward the ischium. In receiving an injury of this type the thigh would be apt to be flexed to a variable degree and thus fixed in the position found. There is also apparent flattening over the greater trochan-



Fig 2 a (left) Traumatic epiphyseal separation in a girl of 12 years b Check up film after reduction by traction and abduction. Note slight overcorrection. Perfect functional result at end of 3 months.

ter but shortening is very slight. The first thought is that of the more common dorsal dislocation, but here the deformity is more extreme while in impacted fracture of the femoral neck, the above deformity would be absent. Whitman states that in all late cases abduction has been lost and weight bearing is painful. The indication then is to secure abduction which in itself tends to reduce the dislocation. In the early cases the treatment, therefore, is the Whitman abduction method similar to the procedure used in cervical fractures. In our experience, very extreme abduction was necessary to prevent redislocation, and we would recommend at least to weeks of complete fixation and an additional 3 months in a walking caliper splint. Coley permitted weight bearing in his patient at the end of 3 months with a satisfactory end result as to painless weight bearing and with about



Fig 3 a (left) Anterior dislocation of right hip in boy of 9 years b Check up film after reduction.





Fig. 4 a (left) Boy 4 years of age with traumatic dislocation of hip b Check up film before application of cast

75 per cent range of motion. If reduction is impossible by manipulation in the old cases, Whitman recommends subtrochanteric osteotomy to secure functional abduction.

It has been the experience of the writers reviewed by the author that the end result even in the cases seen early is that of a deep acetabulum with fair range of motion but usually painless weight bearing. In females with displacement of the fragments into the pelvis subsequent pregnancies should be closely guarded due to the alteration of the parturient canal. In the late cases the permanent disability is considerably greater especially as to range of motion.

**CASE 3.** A lady of 28 years was thrown from a horse alighting on the right great trochanter. Two

days after injury when first seen by Dr. Lord the clinical picture was that of posterior dislocation of the hip. The region over the greater trochanter was very much flattened and the shortening was about three fourths of an inch. The roentgen ray film was most interesting (Fig. 6). A fracture of the acetabulum with central dislocation of the head was found as well as a fracture of the ascending ramus of the os pubis. Reduction of the head was not difficult but maintenance of position was unsuccessful until the extremity was dressed in a degree of abduction much greater than we usually employ for fractures of the neck of the femur. She was immobilized in a cast for 2 months following which a walking caliper was used for 3 months. The functional end result 3 years after injury is very satisfactory in spite of a deep acetabulum which limits complete abduction (Fig. 7).

We feel that a long period of protection is necessary for this type of fracture as the load



Fig. 5 a (left) Traumatic dislocation of the hip with chip fracture of the superior rim of the acetabulum b Reduction with almost exact replacement of detached fragment

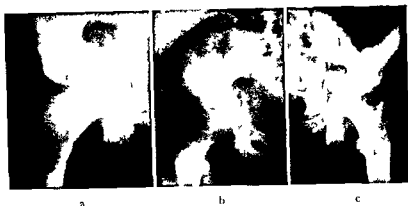


Fig 6 a Central fracture of acetabulum with central dislocation of the head of the femur b Reduction by traction alone c Recurrence of dislocation



Fig 7 a Reduction of central dislocation by extreme abduction (Same patient as in Figure 6) b Reduction maintained by Thomas splint and traction c Final result 3 months after injury showing deep acetabulum with shadow of new bone bridging defect Displaced spicule of bone incorporated in callus forming new roof of acetabulum

of the trunk is carried on the roof of the acetabulum and a very strong bridge must be formed before full weight should be permitted

#### CAPITAL FRACTURES

Fractures of the head of the femur are very rare Christopher was able to collect only 9 proved cases All were the result of very severe injuries and associated with posterior dislocation The etiology apparently is that of impact of the dislocating head against the rim of the acetabulum Burkett, in 1869 reported the first case of this type The fragment of the head to which the ligamentous tissue was attached remained in the acetabulum

and the other portion with the shaft of the femur was posterosuperior The line of fracture was in the same plane as the vertical axis of the shaft which would substantiate a shearing mechanism with the rim of the acetabulum as the cutting edge

Moyn's postmortem report in 1872 is interesting In part the head of the thigh bone lay an inch outside the great sciatic nerve, free under the remains of the glutei A portion of the head of the bone remained in the hip joint attached by the round ligament Evidently on the displacement of the bone some violent force, taking advantage of the leverage the limb afforded, had forced the head of the



Fig 8 a (left) Fracture head of femur with posterior dislocation of neck. Head in acetabulum. Very satisfactory position as revealed by roentgen ray through plaster

femur to plough its way among the muscles. None but a very enormous violence could effect such a terrible injury.

In 4 of the 9 cases reviewed in detail by Christopher, death resulted from the injuries. Three of the remaining 5 had ankylosis as an end result, and 2, including his own, recovered completely.

Treatment consists of reduction of the dislocation and if check up roentgen ray films reveal poor position of the fragments, the operative removal of the loose portion is obviously indicated in order that even a fair functional result may be obtained.

Dr Schrock of our clinic has now under treatment a woman in the forties who in an automobile accident sustained this type of injury as shown in the roentgen ray (Fig 8).

Due to the very severe shock, attempt at reduction was delayed for 3 weeks during which time, however, traction and suspension were used. Under general anaesthesia, manipulation as used in the usual dislocation was carried out and the check up ray through the plaster cast revealed very satisfactory position. However, there is great probability that the fragment of head will absorb due to nutritional deficiency.

A similar type of injury except that greater comminution was present is found in a patient under Dr Lord's care. Here attempted reduction failed and subsequent operation for the removal of the detached fragment of head was performed. The neck of the femur was then placed in the acetabulum and maintained in position by abduction and also by transposition of the greater trochanter with the attached gluteal muscles down on the shaft of the femur. This patient is now in plaster and



Fig 9 a (left) Comminuted fracture-dislocation of hip in a middle-aged man. b Check up film after removal of head. Neck of femur in acetabulum with greater trochanter attached to shaft of femur by temporary steel drill.

with the case of Dr Schrock's will be reported in detail when maximum improvement has been reached (Fig 9).

Durand and Destot have reported 3 cases of fracture of the head of femur without dislocation. The results all have been disappointing as to range of motion and painless weight bearing. This type seemingly, is very rare.

#### TRACTION FRACTURE—LESSER TROCHANTER

The epiphysis of the lesser trochanter appears at approximately 12 years of age and fuses with the shaft at 18 years. Traction fracture of this process, therefore, is an injury of adolescence and review of the literature reveals that 80 per cent occur during this period.

Very frequently, in intertrochanteric fractures, the lesser trochanter is broken free from the shaft but this is not produced by a traction mechanism and no report is found of this occurring independent of cervical fracture.

Balensweig, in 1924, reported 5 cases bringing the total to 38. With the advent of the roentgen ray, many have been recognized as a definite bone lesion, whereas previously a diagnosis of sprain would have been justified on the symptoms and signs.

Straining, as in jumping or vaulting is the usual cause of this injury. Langdon in studying 2 cases, describes very accurately the mechanism. The body is suddenly thrown backward with consequent strain on the iliopsoas muscle as an attempt is made to assume the upright position. This detaches the tro-



Fig 10 (left) Traction fracture of lesser trochanter in young athlete of 16 years. Perfect functional result at the end of 2 months.

Fig 11. Fracture of greater trochanter with displacement. Patient not completely disabled but with increasing symptoms until support was afforded.

chanter, which is pulled upward a variable distance. Disability as a rule is not complete but a dragging limp develops which usually increases. Flexion of the thigh is difficult but in the recumbent position may be partially possible due to the action of the tensor fascia femoris and rectus femoris. In the sitting position further flexion is not possible and this is known as Ludloff's sign. These patients also assume a protective trunk flexion of slight degree when standing and tend to list toward the side affected.

Treatment is best carried out by plaster fixation with thigh flexion of about 45 degrees and slight adduction. With wide separation 90 degrees would be better although check up roentgen rays usually show no change in the position of the fragments in spite of the flexed position. In the mild cases which show simply a separation through the epiphysis as compared with the other side, rest in bed for 2 or 3 weeks gives satisfactory results. Complete recovery in the average case occurs at the end of eight weeks (Fig 10).

#### FRACTURE OF GREATER TROCHANTER

Very little is found in literature of fracture of this process. The author has had the opportunity of treating one case. A man standing on a short ladder, misstepped sustaining an obliquely directed blow to the greater trochanter. Disability gradually increased but walking was possible. The roentgen ray disclosed a linear fracture along the base of the

trochanter which was slightly displaced (Fig 11). A heavy figure of eight strapping and bandage of the lower pelvis and upper thigh proved to be adequate fixation. Recovery was complete in 6 weeks.

#### CONCLUSIONS

We again wish to emphasize the definite age periods for the various traumatic lesions of the hip, the importance of determining the mechanism of injury when possible and the usual conditions which should be borne in mind when a case presents itself for diagnosis.

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## KRUKENBERG TUMOR OF THE OVARY

WITH REPORT OF TWO CASES

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ALTHOUGH cases of this comparatively rare tumor undoubtedly had been previously reported, it remained for Friederich Krukenberg in 1896 with a report of five cases and a detailed description of the gross and histological characteristics to make a definite differentiation between it and the ordinary malignant growth.

He called it *fibrosarcoma ovarii mucocellulare* (carcinomatodes) which name shows that he considered it as primarily a fibrosarcoma with elements in its structure resembling carcinoma. He described it as a solid ovarian tumor almost always bilateral usually associated with ascites characterized by a general growth of the entire ovary and usually free of adhesions. He describes the histological picture as that of a stroma of fibrosarcoma inclosing in its meshwork the characteristic cells or groups of cells which identify it. These are large swollen cells with a mucoid protoplasm and with the nucleus often displaced eccentrically to form the *signet ring appearance*. He believed the tumor to be primary in the ovary.

Since the original description by Krukenberg the most noteworthy study of this interesting growth was made by R. H. Major in 1918, who, after a careful search of the literature collected 55 authentic cases including one of his own. His conclusions after a study of these cases were that histologically the tumor is essentially a carcinoma containing elements of fibrosarcoma that it is not often primary but usually secondary to carcinoma elsewhere and usually to that of the stomach or intestines, that it is bilateral in 90 per cent of the cases collected, and that it is so malignant that in all cases reported in the literature where the later course was known the patients have died. Major's own case was particularly interesting because the diagnosis of carcinoma of the stomach could not be made in the gross but required serial sections to establish this diagnosis. In his case,

also typical Krukenberg carcinoma cells were found in the pulmonic circulation.

The writer, in an effort to collect the cases reported since Major's article in 1919 has found 23 additional ones including the reported for the first time in this paper.

In 1920 Chapman described a Krukenberg tumor removed from a child, 14 years of age which is the youngest case yet reported. This tumor was bilateral and at operation a tumor of the stomach was palpated but not removed. There was no autopsy.

In 1921 Reel added a case, that of a single woman aged 21 years, with the primary growth apparently in the stomach but with additional involvement of the omentum, mesenteries, anterior surface of the spleen, and the large and small intestines.

In 1925 Miller reported 2 cases, one in a woman aged 36 years, a unilateral growth probably secondary to carcinoma of the pylorus, and the second in a woman age unrecorded, but with tumor secondary to an inoperable tumor of the bowel.

In 1926 Shaw reported 5 cases in one of which carcinoma of the stomach was found in 3 of which carcinoma of the stomach was a probable diagnosis, and the final case was lost to view without completed study.

In 1926 Miner described an apparently primary unilateral Krukenberg tumor which was well one year following operation.

In 1924 Gordon reported a bilateral tumor of the Krukenberg type in a negro aged 39 years this was associated with carcinoma of the pylorus.

In 1927 Jarcho added 7 cases 6 of which were from European clinics. In 6 of these cases studied to conclusion, all had gastric carcinoma. One patient disappeared before a complete study could be made.

In 1927 Bell reported 3 cases of Krukenberg tumor, one being unilateral.

To add to the comparatively meager literature on the subject and to describe some

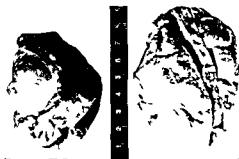


Fig 1 Case 1 J B

characteristics which are unusual in this type of tumor, I wish to report two cases

For the privilege of reporting the first case I am indebted to Doctors V R Mason and M C Terry of Los Angeles

J B a woman aged 43 years consulted a doctor in 1924 for gastric hemorrhage. Studies were made at the time and a diagnosis of gastric ulcer was made. A few months later a tumor was discovered in the pelvis and in February 1925 the abdomen was opened. The uterus and adnexa were removed because both ovaries were found to be replaced by moderately large tumors and the uterus was myomatous. The stomach was palpated and an indurated area was found which was thought to be an ulcer. This area was not removed. The tumors were sent to the laboratory of Terry and Woods Los Angeles who made a diagnosis of Krukenberg tumor of the ovaries. The following is taken from Dr Terry's pathological report. The right ovary alone measures 13 by 8 by 7 centimeters and weighs 250 grams. The left ovary which remains attached to the uterus measures 8 by 7 by 5 centimeters. Both ovaries have preserved somewhat their original shape. The surface of each is irregular. Half of the left ovary is dark and hemorrhagic in color.

Microscopic examination shows the same picture in both ovaries namely a rather loose abundant connective tissue framework in the spaces of which are large round or oval cells apparently distended with mucus. The nucleus lies far out in the margin of the cell giving it the appearance of a signet ring. Diagnosis Krukenberg's tumor of the ovary.

There was considerable nausea and vomiting during convalescence after operation the patient gradually lost weight and died on June 16 1925. There is no record of an autopsy.

The second case Mrs A H was first seen by the writer April 22 1927. She was aged 43 years had been married 9 years was a nullipara and came complaining of slightly increased fullness and slight tenderness in the lower abdomen. There was nothing unusual in the menstrual or marital history except that she had never been pregnant. The

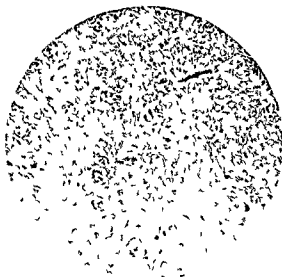


Fig 2 Case 1 J B Signet ring cells well shown with areas of degeneration

gastro intestinal history was negative except that for years the patient had occasionally after meals regurgitated a small amount of food without nausea.

Examination was negative except for the pelvis. The positive points in the pelvic examination were as follows: the cervix was low in the vaginal vault, the uterus was of normal size and pressed firmly downward and forward by a large mass apparently arising from the left adnexal region. This mass was about the size of a small cantaloupe smooth in outline and only slightly tender. In the right adnexal region was a similar but smaller mass about the size of a large lemon.

The patient was operated upon April 27 1927. A moderate amount of straw colored fluid was found free in the abdomen. A smooth, regular non-adherent tumor of the left ovary and a similar tumor of the right ovary were removed together with the tubes. No other pathological process was found in the pelvis or abdomen although the stomach itself was not explored.

The patient made a recovery which was uneventful except that moderate vomiting without nausea persisted for one week after operation.

The laboratory examination made by Dr Roy Hammack definitely established the ovarian tumors to be Krukenberg carcinoma. His microscopic report is as follows: The greater portion of the tissue is fibrous. Occasional definite ovarian structures corpora fibrosa are found. Scattered through the fibrous tissue are epithelial structures of different types. There are a few alveoli with lumina and also solid alveoli. In some areas the cells are scattered through the fibrous tissue without definite arrangement. The most striking type of cell is one which is



Fig 3 Case 2 A H Note smooth surface free of adhesions

distended by a vacuole until only a thin rim of cytoplasm remains. On one side is the elongated flattened nucleus. Such cells form a comparatively small proportion of those present. Mitotic figures are common. The connective tissue is very cellular in some areas and even appears sarcomatous. In the edematous area the epithelial cells are less diffusely scattered and occur in small compact groups.

A complete fluoroscopic and X ray examination of the gastro intestinal tract was made before the patient left the hospital and except for occasional fleeting attacks of nausea there were no digestive disturbances. On July 9 because of a rapidly increasing irregular general enlargement of the left breast this breast was removed. Frozen section made at the table was negative but on serial section many isolated areas of Krukenberg cells were found.

Shortly afterward this patient left Los Angeles and it was impossible to keep her under direct observation although reports were received from time to time. On January 27 1928 she died of general carcinomatosis. The physician sending the report stated that there was considerable ascites and an apparent involvement of the lungs some skin nodules over the upper abdomen and a small recurrence in the pelvis although it could not be ascertained what organ was involved in this recurrence.

Although, unfortunately it was impossible to obtain autopsies on either of the cases reported, it seems highly probable that in the first case the gastric hemorrhages and the indurated area in the stomach which was palpated at operation indicated that the growth was a typical one with the primary tumor in the stomach. In the second case although no examination of the stomach was made at operation, and although fluoroscopic examination and X ray gastric intestinal analysis were negative, there was a history of vomiting, and a primary growth in the



Fig 4 Case 2 A H Relation of carcinomatous and sarcomatous elements well illustrated. Note large mucous cells with eccentrically placed nuclei.

stomach or intestines certainly could not be ruled out without a careful autopsy report. It is quite possible in this case that the breast tumor was the primary growth although the fact that the Krukenberg cells were scattered in isolated areas through it would lend some weight to the theory that it also was a secondary growth.

The original conception of Krukenberg that these tumors are primary has been pretty well refuted by the more recent writers on the subject. Bell states that Krukenberg tumors are now invariably regarded as secondary to gastric carcinoma. However, there appear to have been a few authentic cases of growth primary in the ovaries and also a few primary in other organs such as the breast.

The fact that they are primary carcinomata rather than, as Krukenberg first believed, sarcomata has now become quite generally accepted. It has been suggested by Shaw that ovaries in the childbearing period afford an excellent culture medium for carcinoma cells and that the connective tissue of their stroma can react in an extraordinary embryonic manner to the presence of carcinoma cells in its neighborhood—an adequate explanation for the presence of the secondary stroma sarcomatous elements in these tumors.

Of special interest is the path of transmission of these tumor cells from the primary growth in the gastro intestinal tract to the ovaries, and many theories have been advanced concerning the method of metastasis. Surface infection may be the process in some cases, and Major's case in which the typical Krukenberg cells were found in the pulmonic blood vessels certainly establishes the possibility of the hematogenous route, but there is much evidence to make the lymphatic route suggested by Amann the most plausible one. This theory presumes that the retrogastric and superior lumbar glands are invaded thus producing a blockage of the lymphatic stream and as a result there is a retrograde migration by way of the ovarian lymphatics. Weight is added to this hypothesis in the shape of these secondary tumors which, even when quite large, almost invariably conform to the original form of the ovary, as though the invasion were through the medulla rather than the cortex.

#### SUMMARY

In conclusion, a resumé of our knowledge concerning these rare tumors is as follows:

1 Krukenberg tumors are essentially a form of carcinoma identified by large mucinous cells often with eccentrically placed nuclei.

2 They are almost, if not quite, invariably secondary to carcinoma elsewhere and usually to that in the gastro intestinal tract.

3 They metastasize early and are almost invariably fatal.

4 They are usually bilateral.

5 They grow in a way to produce a general enlargement of the ovary which keeps its general form and is usually free of adhesions.

6 Ascites is usually associated with the tumors.

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# OVARIAN TRANSPLANTATION

WITH THE REPORT OF THIRTY-ONE CASES

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THE importance of the maintenance of the ovarian function is well recognized. A bilateral oophorectomy is sometimes necessary on account of advanced ovarian disease, and when this occurs during the child-bearing period, a proportion of patients suffer as much, or more, from the surgical menopause as from their original condition. Women vary markedly in their reaction to oophorectomy; some suffer little, if any, inconvenience, others go through a moderately severe menopausal change, and in a definite proportion the nervous symptoms are marked and persist for a long period. As a general rule, younger patients suffer more, but this is by no means always the case. The temperament of the patient is a better guide than the age. Some of the most severe incidents of the surgical menopause occur in women over 35 or 40 years of age. The nervous, highly developed, neurotic, married individual is prone to suffer most.

In the surgical menopause, the onset is more abrupt and the symptoms generally somewhat more severe than in the normal menopause. The duration is often somewhat shorter, but no definite prognostication can be made. The fact that a definite proportion of women suffer considerably from the artificial menopause, and that no positive rule can be formulated regarding the degree of discomfort in the individual case, should lead the surgeon to ovarian conservation whenever this can be safely carried out. On the other hand, the conservation of an ovary which will give subsequent trouble is generally worse than are the menopausal symptoms incident to its removal. It is in the latter group of cases that ovarian transplantation, or grafts, are valuable. It seems to be a fact that ovaries function more satisfactorily when the uterus can be preserved, but even in the absence of the uterus the ovarian hormone is elaborated and ovarian conservation is distinctly desirable. As a general principle, the ovary functions better

in its normal position than in any other and for this reason, ovarian conservation should be practiced when this is possible and transplantation or grafting reserved for those cases in which this is inadvisable.

Cases are not infrequently encountered in which the removal of one ovary is imperative and the remaining ovary is so injured or its blood supply impaired, that its conservation in its normal position is accompanied by considerable risk of subsequent degeneration, non-function, and the development of painful symptoms. It is in this type of case that transplantation by the Blair Bell method has been practiced in the accompanying series. This series includes only patients in the child-bearing age, and only those in whom auto-transplantation has been practiced. Ovaries the seat of neoplasms, have not been utilized. Ovaries containing large retention cysts which have been considerably torn during the course of the operation have frequently been pared down and a portion employed for the graft. Practically all the cases herein recorded were suffering from pelvic inflammatory disease. Operation is not resorted to during the acute stage of this disease and as a result most of the ovaries were presumably sterile. A further safeguard is that the graft is made in the rectus muscle and is therefore extraperitoneal and not likely to cause serious trouble even if infection should be present.

In our earlier cases the technique suggested by Blair Bell was closely followed. In our later cases the ovary, after being decapsulated and scored, is divided into 2, 3, 4, or more portions, according to the amount of tissue available, and each is embedded in a separate pocket. As the grafts are smaller, this seems to result in a better blood supply for each. Multiple cysts are less likely to form, and in general a higher percentage of "takes" apparently occurs. In some instances only a small portion of an ovary has been available and this has frequently been utilized. Small

grafts not more than 8 millimeters in diameter and considerably less than this in thickness in our experience have been the most satisfactory

#### TECHNIQUE

As soon as the ovary is removed it is attached to a suture and is placed in the cul de sac or among the coils of intestine in such a position that it will be kept warm and moist. The suture is employed in order that the ovary may be readily located. The intraperitoneal work is completed and the peritoneum is closed in the usual manner except for a small opening through which the ovary is withdrawn by means of the suture. The remainder of the peritoneal wound is closed by an assistant. Immediately upon the withdrawal from the peritoneal cavity the ovary is placed upon a hard surface and decapsulated. An extremely sharp knife facilitates this procedure. Care should be used to make decapsulation complete but not to sacrifice more ovarian tissue than absolutely necessary.

The decapsulated ovary is then freely and deeply scored. It is divided into pieces, none of which are more than 6 or 8 millimeters in diameter or more than 3 or 4 millimeters in thickness. The fat is dissected away from the aponeurosis of the rectus, and an incision is made through the latter. This incision should be just large enough to permit the passage of the graft. With the handle of the knife or a hemostat the fibers of the rectus muscle are gently separated and the graft is inserted. The graft should be completely surrounded by the muscle and not placed between the muscle and fascia. Care must be exercised in separating the fibers of the rectus not to produce bleeding. If a hematoma forms the chances of a "take" are greatly diminished. If the separation of the muscle causes bleeding it is better to check the bleeding, close the aponeurosis, and make a new bed for the graft rather than employ one which is oozing. After the graft is placed in the muscle, the small opening in the aponeurosis of the rectus is closed by one or more fine catgut sutures. The above procedure is repeated for each graft. The remainder of the laparotomy wound is then closed in the usual manner.

We have not attempted grafting when drainage has been necessary. If grafts are to be employed in a case in which drainage is advisable, the ovarian tissue should be embedded in the wound as far as possible from the drainage tract. Strict asepsis and hemostasis are essential for the success of the grafts.

The operation should not increase the mortality, and beyond adding a few minutes to the length of anesthesia should not result in complications.

The disadvantages of this form of graft are (a) the presence of the graft makes primary healing slightly less likely, (b) if infection of the wound occurs the graft may not "take," (c) the graft may not "take" because of the presence of a small hematoma or some other reason. The more remote complications are (d) the life of the graft is probably limited to 2 or 3 years, (e) retention cysts may develop in the graft causing pain and requiring evacuation, or removal of the ovarian tissue. (f) Even without a demonstrable enlargement of the graft, it not infrequently becomes tender for a day or two at monthly, or irregular, intervals. These periods are probably caused by the development of a graafian follicle. If the graft "takes" but insufficient ovarian tissue is present to prevent the development of the menopausal symptoms the latter are prone to continue over a longer period than if bilateral oophorectomy alone had been performed.

It was with the hope of further reducing the incidence of these complications that the modification of the original method was attempted. In our experience the smaller multiple grafts seem to have functioned as satisfactorily as have the larger grafts, and have reduced the proportion of cases in which the grafts became tender. On theoretic grounds, it would seem that small grafts should become vascularized more quickly, that the proportion of "takes" should be greater, and the likelihood of the development of multiple retention cysts which might require removal should be lessened.

#### ADVANTAGES

The advantages of this form of ovarian transplantation are (a) that complications rarely develop (b) If they do they are of

minor importance and can easily be rectified by removal of the graft under local anesthesia, or a few inhalations of nitrous oxide gas and do not involve a major operation. This is not the case with intraperitoneal grafts and is an important point. (c) This form of graft is not a substitute for the conservation of the ovary in its normal position. It is applicable to cases in which conservation is not possible and may be utilized even when only a small portion of the ovary is available. (d) The grafts usually "take." (e) The sudden development of the menopause is generally averted, and when it occurs is more analogous to the normal than if the grafting had not been performed.

#### RESULTS

This series consists of 31 cases, among which there was no mortality. The after histories of 25 of these cases have been secured. These vary from 6 months to  $3\frac{1}{2}$  years since the time of the operation. Nearly all have been examined personally by one of the authors. Among the 31 cases there were two small stitch abscesses in one, in the remaining cases the wounds healed *per primam*. All the wounds are strong and no hernias have developed. The patients ranged from 21 to 39 years, the average age being 29.1 years. Bilateral salpingo-oophorectomy was performed in all cases except one. In this case the left tube and ovary had been removed 10 years before the right salpingo-oophorectomy which was performed in our clinic. As far as can be determined all of the ovarian tissue was removed in each case. In all the cases, pelvic inflammatory disease was present and in some was associated with uterine myomata. In the majority of cases, the pelvic inflammatory disease was extensive. In the milder cases of pelvic inflammatory disease, which require operation, it is generally possible to conserve an ovary in its normal position. Ovarian grafting was reserved for those cases in which this was impossible. There were 6 cases in which the uterus was conserved. All of these have menstruated regularly. They vary from 9 to 17 months since operation, the average period being 12.25 months.

When the menopausal symptoms develop after a hysterectomy, it is somewhat difficult

to grade its severity properly. As the technique of grafting is the same when the uterus is conserved, the latter cases would seem to be an excellent guide regarding the proportion of "takes" which occur.

Whereas the above series is too small from which to draw accurate conclusions, it would indicate that a high percentage of the grafts functionate. There is usually a period of amenorrhoea lasting from 2 to 7 months following the operation, which probably corresponds to the time required to establish the circulation in the graft and for the latter to resume its power of functioning. The first menstrual period in one case was prolonged and profuse. After re-establishment of the flow, the periods were regular and normal. The 19 cases in which hysterectomies were performed showed the following results:

Menopausal symptoms	Cases	Percentage
Severe	2	10.5
Moderate	5	26.3
Mild	4	21
Absent	8	42.2

In this series the period since operation varies from 3 months to  $3\frac{1}{2}$  years, the average being 16.2 months.

For a few months following operation the symptoms are often similar to those which would be expected if the grafting had not been performed. In some of our cases definite menopausal symptoms of flushing, nervousness, etc. have developed. In a few months these disappeared and the patient has undergone all the manifestations of menstruation except the actual bleeding. It is not uncommon for these patients to state that they felt as if they were going to menstruate, or to ask why they do not bleed when they have all the premonitory symptoms. As none of our cases has been operated upon more than  $3\frac{1}{2}$  years we are unable to state the duration of the life of a graft by this method. None has required a second operation so that results of histological studies of the transplants are not available.

As has been stated, it is extremely difficult to classify the severity of menopausal symptoms in general and especially those which follow surgical intervention. As a possible means of comparison for the results previously recorded in the cases which have been treated

by transplantation the following figures are submitted (Table I)

The figures in Table I are arbitrary and would probably vary with different series. We do not believe that bilateral salpingo oophorectomy, conservation of the uterus, and ovarian transplantations will in a large series give better results as far as the absence of menopausal symptoms are concerned than will unilateral salpingo oophorectomy. The only advantage of the latter is that if the transplant requires subsequent removal this can be performed with less risk to the patient than can the removal of an offending ovary within the peritoneal cavity. There is every reason to believe that other things being equal an ovary will function more satisfactorily in its normal situation than in any other.

Unterberger engrafted discs of ovarian tissue into the rectus muscle. A period of amenorrhea lasting 2 to 7 months occurred which was followed in the majority of cases by regular menstruation. In young women the menses continued for 5 years but when the women were over 40 the menopause soon developed. Kross believes that young tissue is more suitable for grafting. Cramer found that menstruation occurred in 18 of 19 cases in which the uterus was preserved and that menopausal symptoms were absent in 30 of 37 cases in which hysterectomy was performed. Transplantation was performed into the space of Retzius. Bell studied the results in 67 cases. In 57 the uterus was preserved. In this group menstruation occurred in 38, there were no menstruation and no menopausal symptoms in 9, menopausal symptoms were present in 9. In 10 cases hysterectomy was performed of these menopausal symptoms were present in 3 and absent in 7. Bell believes that transplantation is contra indicated in women over 42 years of age and in those who are sexually inactive. He found menorrhagia not unusual for several months during the re establishment of the menstrual function. Bell employs ovarian and thyroid extract after operation and believes that this treatment relieves the menopausal symptoms until menstruation re appears.

Lack records benign cystic degeneration in transplants and Bell records 2 such cases

TABLE I—A COMPARISON BETWEEN THE RESULTS SECURED WITH AND WITHOUT OVARIAN TRANSPLANTATIONS

	MENOPAUSAL SYMPTOMS			
	Absent	Mild	Moderate	Severe
Hysterectomy and bilateral alpingo oophorectomy 1682 cases (Payne and Priestley)*	25% <sup>c</sup>	72% <sup>c</sup>	Present not graded	
Hysterectomy and bilateral salpingo oophorectomy (Steinhardt)†	14% <sup>c</sup>	35% <sup>c</sup>	39% <sup>c</sup>	21% <sup>c</sup>
Hysterectomy and bilateral salpingo oophorectomy and ovarian transplantation (Norris and Behney)	42% <sup>c</sup>	21% <sup>c</sup>	26% <sup>c</sup>	10% <sup>c</sup>
Unilateral alpingo-oophorectomy (Payne and Priestley)*	85% <sup>c</sup>	26% <sup>c</sup>	Present not graded	
Bilateral salpingo-oophorectomy and ovarian transplantation (Norris and Behney)	100% <sup>c</sup>			

\*Payne, F. L. and Priestley, J. University of Pennsylvania—From a study of end results which paper was read at the May 1919 meeting of the Philadelphia Obstetrical Society.  
†Steinhardt, B. Ztschr. f. Geburtsh. u. Gynaek. 1927, xxi, 361

among 150 grafts. Hallauer believes that autotransplanted ovaries retain their vitality for 2 or 3 years and often longer.

Sippel states that autotransplantation is indicated in young women of sexual maturity in whom bilateral adnexal disease has necessitated the removal of both ovaries and tubes. By this operation the worst symptoms of the artificial menopause are avoided, and ovarian function is preserved. This author reports the results in 9 cases, in 7 the result was successful. Premenstrual changes were observed in the endometrium in 3 cases. Both the unsuccessful cases were over 40 years of age. Schultz reports 9 cases of which 8 were successful.

#### CONCLUSIONS

1 Ovarian transplantation is not a substitute for conservation of the ovary in its normal situation and should be reserved for those cases in which this is inadvisable.

2 The life of the transplanted ovary is probably not more than 2 or 3 years.

3 Grafts frequently become tender for a day or two each month. They rarely give serious trouble.

4 The operation is practically without mortality or morbidity

5 Most of the grafts "take"

6 When the menopause occurs it is generally more prolonged, gradual, and analogous to the normal menopause than if grafting had not been performed

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## SALPINGITIS

A DETAILED ANALYSIS BASED ON THE STUDY OF FIVE HUNDRED FORTY FIVE CASES—JANUARY, 1914 TO DECEMBER, 1927, INCLUSIVE<sup>1</sup>

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IT will become evident that the diagnosis, differential diagnosis, and proper treatment of salpingitis comprise a very important portion of modern surgery, not only for the gynecologist but for the general surgeon. It will also be evident that salpingitis is a definite clinical entity, and although it simulates and is simulated by other conditions, there are many characteristic features.

## CLASSIFICATIONS

There are many classifications, such as those referring to that portion of the tube involved: interstitial, parenchymatous, mural, and so forth, those that refer to the pathological etiology, such as purulent, gonorrhoeal, tuberculous, staphylococcal, and other forms. However, in this study the types of cases will be referred to under the following classifications, it being considered the most practical clinically: (1) acute, (2) acute exacerbation, (3) chronic, and (4) tuberculous.

Of the 545 cases, 115 were acute, making 21.1 per cent, 114 were acute exacerbation or 20.9 per cent, 293 were chronic or 53.7 per cent, and 26 or 4.7 per cent, were tuberculous.

## AGE

The disease occurred in persons as young as 11 and as old as 60 years. The average age was 28.7 years.

Four patients were under 16 years of age, namely, 11, 12, 13, and 15 years. Three of these patients had never menstruated. It is a well known fact that gonorrhoeal vulvitis and vulvovaginitis are rather frequent in children, sometimes being epidemic in nature. None of these 4 cases, however, gave the his-

<sup>1</sup>The term "acute exacerbation" is generally used as a reference to a chronic disease in which a sudden flaring up of the infection occurs. It is used more as a separate entity here because there is such a great difference between most of the chronic cases and the acute exacerbations. The determination of the acute exacerbation was in many cases pathological and not because the patient gave the history of a chronic salpingitis. Most of the histories of acute exacerbations simulated those of the acute cases.

tory as being of that type. It is probably rare that the form of gonorrhoeal vulvovaginitis usually seen in little girls extends upward, causing salpingitis. It is possibly true that salpingitis is caused by gonorrhoeal infection introduced by sexual intercourse only. There are, however, a few exceptional cases.

There were 95 young women in our series between the ages of 16 and 21, inclusive, 6 of them were 16 years old, 7 were 17, 9 were 18, 24 were 19, 24 were 20, and 25 were 21 years of age.

The ages of the acute cases varied between 11 and 60 years, the average being 25.8 years.

The ages of the acute exacerbations varied between 17 and 51 years, the average being 30.4 years.

The youngest chronic case was 16 years, the oldest 50, the average being 29.5 years.

The youngest tuberculous case was 20 and the oldest 40 years, the average being 26 years.

The deduction to be drawn from this study of ages is that age alone plays little part in the determination of the type or incidence of the disease.

## MARITAL

Four hundred and twenty of the patients were married, 83 were single, 37 were widowed, and 5 were divorced. According to these figures only 15.2 per cent of the women had not been married. This may or may not be accurate, depending on the honesty of the patients.

## OCCUPATIONS

Sixty-two histories failed to give the record of any occupation. It would be interesting to know what proportion of women with salpingitis are or have been prostitutes. It was impossible to obtain any information on that subject, as the internes who took the histories were either unable to elicit such data or were reticent in recording it.

<sup>1</sup>Read before the Surgical Section of the New York Academy of Medicine, November 2, 1928.

Three hundred eight women were housewives or were occupied in doing housework. Fifty nine were domestic servants, such as cooks, chamber maids, waitresses, hat check girls, etc. Thirty six were factory workers, ten were saleswomen, ten were actresses or professional dancers, and nine were telephone operators. There were also seven dressmakers, seven stenographers, six clerks, five embroiderers, four schoolgirls, four school teachers, four milliners, two bookkeepers, two manicurists, two needle workers, two corset fitters, two cashiers, two designers, and one social worker.

Thus, no conclusions can be drawn from these occupational statistics.

#### LEUCOCYTOSIS

The statistics given below refer to the leucocytosis present within a few hours or during the first day of admission to the hospital. Subsequent counts varied according to the type and progress of the case, virulence of infection, and resistance of patient.

*All cases* The general average count in all cases was 14,589 leucocytes with 79.6 per cent polymorphonuclears. The highest count was 45,300 and the lowest 4,400. The highest percentage of polymorphonuclears was 98 and the lowest 34.

*Acute cases* The highest leucocytosis in the acute types was 45,300, the lowest 6,900, the average being 16,790. The highest percentage of polymorphonuclears was 98, the lowest 61, the average being 84.2.

*Acute exacerbation cases* The highest leucocytosis in acute exacerbations was 36,000, the lowest 8,000, the average being 16,875. The highest percentage of polymorphonuclears was 95, the lowest 64, the average being 82.8.

*Chronic cases* The highest leucocytosis in the chronic form was 28,400, the lowest 4,400, the average being 11,087. The highest percentage of polymorphonuclears was 90, the lowest 34, the average being 73.5.

*Tuberculous cases* The highest leucocytosis in the tuberculous form was 23,000, the lowest 6,000, the average being 12,580. The highest percentage of polymorphonuclears was 88, the lowest 67, the average being 78.7.

One of the deductions from this study is that leucocytosis is present in practically all cases of salpingitis, even of the chronic and tuberculous types. Another deduction is that the leucocytosis is relatively higher than the temperature—there usually being a leucocytosis even without pyrexia. This would not be found in a similar study of appendicitis. It is safe to state, then, that the leucocytosis of salpingitis is consistently higher than that of appendicitis. The relative polymorphonuclear count is high in all forms, this fact is of special interest in the tuberculous variety where it might not be expected.

#### FEVER

The relation of fever to salpingitis refers only to the temperature on admission to the hospital. The highest temperature was 105.2 degrees, the lowest 97.6, and the average 99.5.

*Acute cases* The highest temperature was 105.2 degrees, lowest 98, the average 101.32.

*Acute exacerbation cases* The highest temperature was 104 degrees, the lowest 98.4, and the average 101.08.

*Chronic cases* The highest temperature was 101.3 degrees, the lowest 97.6, and the average 98.12.

*Tuberculous cases* The highest temperature was 104.1 degrees, the lowest 98, and the average 100.

As has been previously stated under "Leucocytosis," the leucocyte count is usually relatively higher than the rise in temperature. Notwithstanding this, there is a constant pyrexia in practically all cases of salpingitis, which is no doubt higher than would be found in a similar appendicitis series. An elevation of temperature of 101.32 degrees would be high for an acute appendicitis, but it is only the average for this series of acute salpingitis. This is contrary to some textbook teachings.

#### HISTORY, SYMPTOMS, AND PHYSICAL SIGNS

The history of previous attacks of salpingitis varied from 2 weeks to 15 years, the average remote onset being 4½ months before admission to the hospital.

The duration of the present illness varied between a few hours and 3 months, the average time being 12½ days before admission.

The important complaints in the histories were nausea alone (without vomiting) in 58 or 10.6 per cent of cases, nausea with vomiting in 179 or 32.8 per cent of cases. Thus, 237, or 43.4 per cent of the patients, complained of either nausea or vomiting or both.

Indigestion in 53 or 9.7 per cent. The term indigestion refers to the complaints of heaviness in the epigastrium, heartburn, gastric distention, and the belching of gas and sour material. As this syndrome was so prevalent, it suggests a comparison between the digestive disturbances of appendicitis and upper abdominal diseases. The digestive complaints in these 53 salpingitis cases simulated those of upper abdominal disease, such as peptic ulcer or cholecystitis, rather than of appendicitis.

Headache in 76 or 13.9 per cent. There is evidently some peculiar association between salpingitis and headache, it probably not being due to fever alone, because it occurred many times when there was little or no fever. In some of these, headache was the chief complaint. This is possibly an ovarian reflex similar to the headache occurring with menstruation.

Dysuria in 100 or 18.3 per cent and urinary frequency in 68 or 12.4 per cent. These two complaints have commonly been considered cardinal symptoms of salpingitis. However, their incidence appears relatively small.

Gonorrhœal history in 16 or 2.9 per cent. Almost invariably was blamed on the husband.

Vaginal discharge in 348 or 63.8 per cent. This, although it was either elicited in the history or found on examination, was usually a complaint. In many cases there was no foul yellowish discharge—only a complaint of leucorrhœa. This manifestation has also been considered as pathognomonic of salpingitis. However, 36.2 per cent gave no history or manifestation of vaginal discharge.

Dysmenorrhœa in 122 or 22.3 per cent. Dysmenorrhœa is not of as great importance as it is usually considered. It was only present in 22.3 per cent of cases, many of which had other pelvic diseases that might have been the cause of the dysmenorrhœa.

Irregular menstruation in 171 or 31.3 per cent.

Location of the complaint of pain. Both lower abdominal quadrants in 261 or 47.8 per cent of cases, right lower quadrant in 170 or 31.1 per cent, left lower quadrant in 94 or 17.2 per cent, back in 174 or 31.9 per cent.

Epigastrium in 24 or 4.4 per cent. Only 4.4 per cent of the patients complained of pain in the epigastrium, in differentiation from appendicitis, in which it is a well established fact that the majority of patients complain of pain in the epigastrium, at least during the onset of the attack. Also, in appendicitis, after the pain arises in the epigastrium, it soon radiates to the lower right quadrant, while in salpingitis, if the pain is in the epigastrium, it usually remains there without any radiation.

Other locations of pain were: Shoulder in 13 or 2.3 per cent, thigh in 31 or 5.6 per cent, leg or legs in 27 or 4.9 per cent, genitalia in 7 cases, rectum in 4, breast in 2, axilla in 1, arms in 2, precordium in 2, upper right abdominal quadrant in 4, chest in 7, groin in 4, midabdomen in 2.

Other factors. Vaginal bleeding in 43 cases, chills in 74, complaint of fever in 73, sweats in 9, menorrhagia in 9, metrorrhagia in 11, salpingitis symptoms after the menopause in 3, before menstruation in 3, during pregnancy in 3, and associated with syphilis in 9.

Onset of attack of salpingitis was preceded by the following: Miscarriage in 36 cases, delivery in 36 cases (these together make 72 or 13.2 per cent of the cases which may be considered of puerperal origin. It was impossible to determine whether or not there was gonorrhœa).

By vaginal examination, masses were found in 207 or 37.9 per cent of the patients. The locations of the masses were: both lateral fornicies in 46 or 8.4 per cent of cases, right fornix in 82 or 15 per cent, left fornix in 62 or 11.3 per cent, posterior fornix or cul de sac in 36 or 6.6 per cent.

Other physical findings were. Abdominal distention was mentioned only 9 times, abdominal masses were found in 46 or 8.4 per cent of cases, which is low compared with the number of vaginal masses found, but shows that they are found abdominally in an appreciable number, retroversion in 27, negative



examination in 23 (in these cases the diagnosis was made on the history alone, usually that of repeated attacks), tender cervix in 20, thickened fornices not sufficient to call a mass in 30, retroflexion in 3, enlarged inguinal lymph nodes in 1, acute urethritis in 1, enlarged uterus in 8, tender uterus in 6, fixation of the cervix in 3, laceration of the cervix in 2, hæmaturia in 1, anteversion of the uterus in 1, tenderness in the flank in 1, jaundice in 1, prolapse of the uterus in 2, fixation of the uterus in 1, subinvolution of the uterus in 1, cystocele in 1, labial herpes in 1, lump in the vagina in 1

#### DIAGNOSIS

An accurate history is often impossible as this type of patient is frequently untrustworthy or ignorant, thus necessitating considerable care in the eliciting of data. It is, therefore, important that care be used to obtain a very accurate and complete history and to make a thorough physical examination in salpingitis in order not to make mistakes in diagnosis, because there are many conditions simulating it. Doubtless, in this series, the cases were well studied and judged with discretion, but these determinations were not always incorporated in the records. Therefore, while some of the records appeared to show carelessness, indefiniteness or incompleteness in history taking—several mistakes actually being made, such as incorrect diagnoses, or operating at wrong time or without proper indications, or diagnosing complications but missing the salpingitis—this may have been only apparent. Whether or not there was any carelessness, emphasis is laid on the great importance of care, thoroughness, and accuracy, because salpingitis is by no means to be treated routinely or without deliberation.

Two hundred ninety five or 54.1 per cent of cases were quite definite and easily diagnosed, 72 or 13.2 per cent were fairly easy to diagnose, 25 or 4.58 per cent were indefinite—the diagnosis not being certain, 76 or 13.8 per cent were difficult to diagnose, 39 or 7.1 per cent were either carelessly or wrongly diagnosed or else their case histories were indefinite and incomplete and the physical examinations were lacking in details.

#### MISTAKES IN DIAGNOSIS

In 388 or 69.6 per cent of cases, salpingitis was correctly diagnosed. In 16 or 2.8 per cent, no diagnosis was made before operation, the postoperative diagnosis being salpingitis. The remaining cases, 103 or 27.4 per cent, were wrongly diagnosed and were operated upon with the following diagnoses, the postoperative being salpingitis. Appendicitis in 53 cases, retroversion of the uterus in 18, ectopic gestation in 15, cystic ovary in 15, salpingitis was diagnosed, but not tuberculous salpingitis in 13 cases which turned out to be tuberculous, tuberculosis of the fallopian tubes is considered a separate disease entity, but it is worthy of note that M. Salmon reports a case of tuberculous salpingitis associated with acute gonorrhœa, fibromyoma of the uterus in 12, laceration of the cervix in 3, intestinal obstruction in 2, prolapse of the uterus in 2, abdominal adhesions in 2, incomplete abortion in 2, cyst of the broad ligament in 2, pregnancy in 1, ruptured peptic ulcer in 1, gastric ulcer in 1, acute cholecystitis in 1, cholelithiasis in 1, general peritonitis in 1, pelvic tumor, unclassified, in 1, endometritis in 1, metrorrhagia in 1, menorrhagia in 1, carcinoma of the uterus in 1, pelvic cellulitis in 1, typhoid fever in 1.

It is probably untrue that this large proportion was wrongly diagnosed, the records are in many instances quite vague in this regard. For years no pre-operative diagnosis was made, that is, there was none recorded. However, this shows that wrong diagnoses often occur, and are not infrequently of considerable importance.

#### DIFFERENTIAL DIAGNOSIS

It was necessary to consider the following conditions in the differential diagnosis. Many of them were found to be present as complications. All of them caused symptoms and signs which simulated in some way those of salpingitis. The conditions that were actually present as complications will be again taken up under the heading "Complications."

1. In 103 or 18.8 per cent of cases appendicitis in many of its forms (acute, chronic, ruptured appendiceal abscess, etc.), ectopic gestation, right or left, ruptured or unrup-

TABLE I—DIFFERENTIAL DIAGNOSIS

Diagnostic factors	Salpingitis	Appendicitis	Ectopic pregnancy	Cystoma of ovary	Fibroid uterus	Retroversion of uterus	Chronic endometritis	Uteral colic
Previous attacks	Likely	Possibly	None	Likely	None	Indefinite	Indefinite	Likely
Temperature elevation	Usually higher than in appendicitis	Usually	Slight	None	None	None	Usually none	None
Leucocytosis	Present higher than in appendicitis	Present	Very slight	None	None	None	Usually none	None
Nausea	Often present continually	Often present early	Morning	Often present	None	Occasionally present	None	Usually present
Vomiting	Often present	Often present	Usually none	Usually none	None	Occasionally present	None	Occasionally present
Indigestion	Ulcer type	Nausea and vomiting	Early pregnancy type	Nausea	None	Usually none	None	None
Headache	Often present	None	None	Occasionally present	None	Occasionally present	None	None
Dysuria	Often present	None	None	None	Often present 25 per cent	Often present	None	Frequent
Urinary frequency	Often present	None	None	None	Often present 25 per cent	Often present	None	Present
Vaginal discharge	Usually present	None	Bloody spotting	Usually none	Usually with menstruation	Leucorrhœa	Persistent leucorrhœa	None
Irregular menstruation	Usually present	None	Present	Present	Menorrhagia	Prolonged menstruation	None	None
Dysmenorrhœa	Usually present	None	None	Present premenstrual	Usually none	Present	Present	None
Location of pain	Bilateral L. or R. L. Q.	Epigastrium and L. R. Q.	Unilateral	Unilateral or bilateral	Pressure pains	Backache	Indefinite	Course of ureter
Tenderness	Usually bilateral	Left lower quadrant	Slight unilateral	Unilateral or bilateral	Non-tender mass	None	Slight abdominal	Unilateral abdominal
Rigidity	Bilateral L. or R. L. Q.	Left lower quadrant	None	None	None	None	None	Unilateral abdominal
Vaginal examination	Bilateral tender or mass	High or tender, no mass	Soft mass unilateral	Ovary or cyst palpable and tender	Hard mass non-tender	Cervix forward uterus backward	Indefinite	Negative
Vaginal bleeding	Occasionally present	None	Present	None	Menorrhagia	Menorrhagia	Menorrhagia	None
Special								Hæmatoma X-ray

tured, in 40 or 73 per cent, cystoma of ovary unilateral, bilateral ruptured, or infected, in 37 or 67 per cent, carcinoma of the ovary in 1.

2 Uterine conditions were Fibroid uterus in 34 or 62 per cent of cases, retroversion in 29 or 53 per cent, retroflexion in 3, anteversion in 1, ante flexion in 1, prolapse in 2, subinvolution in 1, double uterus in 1, infantile uterus in 1, endometritis acute or chronic, in 26 or 47 per cent, pregnant uterus in 11, incomplete abortion in 5, ruptured uterus in 1, carcinoma of the uterus in 1, metrorrhagia in 1.

3 Extra uterine conditions were Cyst of the broad ligament in 5 cases, pelvic neoplasm,

unclassified, in 4, parametritis in 1, pelvic hæmatoma in 1, pelvic cellulitis in 1.

4 Abdominal conditions were Abdominal pregnancy in 1, abdominal adhesions in 6, acute diverticulitis in 4, acute or subacute intestinal obstruction in 3, general peritonitis in 3, tuberculous peritonitis in 1, pneumococcus peritonitis in 1, visceroptosis in 1, constipation in 2, gastro enteritis in 2, intestinal parasites in 1, abdominal lymph nodes in 1.

5 Upper abdominal and urinary tract conditions were Gastric ulcer in 7 cases, acute cholecystitis in 7, pleurisy in 1, pyelitis in 1, nephroptosis in 2, hydronephrosis in 1, ureteral colic in 3, cystitis in 1.

6 Conditions of the cervix were Lacerations in 5, stenosis in 2, endocervicitis in 1, cystocele in 1

7 Other general conditions were Typhoid fever in 2, malarial fever in 1, septicæmia in 1, migraine in 1, neurasthenia in 1, alcohol poisoning in 1, sterility in 1, glandular dystrophy in 1, hæmorrhoids in 1

A study of the foregoing cases indicates that the most important and the most frequent conditions to be differentiated are—in order of their incidence—appendicitis, ectopic gestation, cystoma of ovary, fibromyoma of uterus, retroversion of uterus, endometritis, and ureteral colic, as shown in Table I

The number of cases operated upon were All Cases 437 or 80.2 per cent of admissions, not operated on, 108 or 19.8 per cent. Acute 79 or 69.3 per cent of admissions, not operated upon, 35 or 30.7 per cent. Acute exacerbations 95 or 83.3 per cent of admissions, not operated on, 19 or 16.7. Chronic 240 or 82.2 per cent of admissions, not operated on, 52 or 17.8 per cent. Tuberculous 25 or 96 per cent of admissions, not operated upon, 1 or 4 per cent. Besides these, were 5 acute exacerbations and 21 chronic cases upon which operation was advised, but was refused

The advisability of operation in some of the foregoing types will be considered later under the heading "When to Operate"

#### COMPLICATIONS

There were 89 or 16.3 per cent of uncomplicated cases, not including many in which the appendix was slightly involved in the process or chronically diseased—all of these being classed as complications

There were 287 cases in which the appendix was involved, that is, involved at least in the operative procedure, not necessarily in the disease process, many being normal appendices which were removed as a prophylactic measure. Ten of the cases were classed as acute per appendicitis, that is, infection of the outer coats first by contiguity of tissue from the tubes. Many were chronically diseased, but very few were acute. One was tuberculous

Ovarian disease was the next most common complication, there being 273 or 50.1 per cent of cases, 161 were considered as oophoritis,

unilateral or bilateral, 103 as cystoma of the ovary, 1 as prolapse of the ovary, 3 as teratoma of the ovary, 3 as tuberculosis of the ovary.

1 Many conditions of, or involving the uterus were found as complications. Endometritis in 74 cases, one of which was tuberculous, retroversion in 63, retroflexion in 2, fibromyoma in 24, bicornuate uterus in 1, metrorrhagia in 1, incomplete abortion in 4, unruptured ectopic pregnancy in 2, abscess of uterus in 1, cyst of uterus in 1, prolapse of uterus in 1, normal pregnancy in 3

2 Other complications were Lacerations of the cervix in 9, relaxation of the perineum in 9, erosion of cervix in 2, fibroma of cervix in 2, stenosis of cervix in 1, hypertrophy of cervix in 2, Bartholin's cyst in 2, perineal fistula in 1

3 Among the extragenital abdominal complications were Wound infection in 14 cases, intraligamentary cysts in 13, general peritonitis in 28, one of which was tuberculous, acute cholecystitis in 5, cholelithiasis in 1, perforation into cæcum in 2, ascariis lumbicoides in 1, trichinosis in 1, fecal fistula in 7, peritoneal adhesions in 16, Meckel's diverticulum in 1, ventral hernia in 2, Lane's link in 1, acute dilatation of the stomach in 1, gastroptosis in 1, acute intestinal obstruction in 1, abdominal sinus in 1, gastro-enteritis in 1, pancreatitis in 1, constipation in 1

4 Urinary conditions as complications were Cystitis in 2, pyelitis in 2, nephritis in 2, lacerated wound of ureter in 1, chronic urethritis in 1, nephrolithiasis in 1, nephropotosis in 1

5 Pulmonary complications were Pulmonary embolus in 2, lobar pneumonia in 2, bronchopneumonia in 2, bronchial asthma in 1, pulmonary tuberculosis in 4, pleurisy in 1, atelectasis in 1, lung abscess in 1

6 Other general complications were Syphilis in 12, chronic cardiac valvular disease in 4, hæmorrhoids in 3, ether narcosis causing death in 2, and one case each of the following sterility, cerebral accident, epilepsy, constitutional psychopathy, anæmia hæmatoma of back, goiter, phlebitis, inguinal lymphadenitis, aneurism of the aorta, hysteria, axillary abscess, and surgical shock

Although diseases of the appendix, uterus, and ovaries are most often associated, the

foregoing study demonstrates that there are many other conditions which complicate salpingitis. The involvement of the appendix is mostly a matter to be concerned with in the differential diagnosis, the involvement of the ovaries is so frequent that it is practically considered with the pathology of the salpingitis. The involvement of the uterus is not only a large factor in the differential diagnosis but also in the prognosis. Due to the numerous and varied complications arising with salpingitis, it is often advisable to have consultations between the gynecologist and the general surgeon.

#### PREGNANCY

*Pre operative pregnancies.* Of the 545 cases, 299 or 54.8 per cent had had pregnancies, 195 had had no pregnancies, and in 51 either the patient would not volunteer the information or that part of the history was neglected. Of the 299 women who had had pregnancies there had been a total of 806 pregnancies, an average of 2.69 per patient, there were 443 children living and well, an average of 1.47 per patient, 93 children who had died, an average of 0.31, and 270 miscarriages, criminal abortions, premature labors, etc., an average of 0.90. Of the 26 tuberculous patients 16 had had no pregnancies before operation, in 5 cases this history was not elicited, and 4 had had pregnancies, each having one child living and well, one having had one miscarriage, and one having had a child that died.

*Postoperative pregnancies.* There were 16 patients who reported pregnant. 1 patient came in definitely pregnant, 3 had had children who were living and well, 6 came in complaining of symptoms of early pregnancy and were probably pregnant, 4 were later admitted to the hospital and operated upon for ectopic pregnancy, 2 had miscarriages. In the tuberculous cases, no pregnancies were reported after operation.

That it is possible for pregnancy to occur after a large part of the adnexa has been removed and following infection of the tubes and ovaries, will be shown in the following reports of cases wherein the patient became pregnant after operation, it being left to the judgment of the reader as to whether or not some of them were actually pregnant.

1 Eight months after a right salpingo oophorectomy and appendectomy for chronic salpingitis, the patient was readmitted and operated on for left tubal gestation.

2 Five months after bilateral salpingectomy and right oophorectomy, the patient complained of occasional pain in the back and lower abdomen, with amenorrhœa, and thought that she was pregnant.

3 One year after right salpingo oophorectomy and freeing of adhesions the patient had a normal pregnancy and delivery.

4 Three years after bilateral salpingectomy and appendectomy, the patient had a miscarriage.

5 Nine months after left salpingo oophorectomy, appendectomy, and dilatation and curettage, the patient was definitely pregnant.

6 Four years after right salpingectomy and excision of cystoma of ovary and appendectomy the patient was readmitted for left tubal gestation.

7 Two and one half years after bilateral salpingectomy and left oophorectomy, the patient had a miscarriage.

8 Two years after bilateral salpingectomy, left oophorectomy, appendectomy, dilatation and curettage and myomectomy, the patient was thought to be pregnant.

9 Seven and one half months after left salpingectomy, the patient had a normal pregnancy and delivery.

10 Ten months after right salpingectomy, appendectomy, and dilatation and curettage, the patient was thought to be pregnant.

11 Three months after left salpingo oophorectomy appendectomy and dilatation and curettage, the patient was thought to be pregnant.

Other cases on record were quite indefinite and may or may not have been pregnant.

#### OPERATIVE PATHOLOGY

Bilateral salpingectomy was done in 292 cases or 53.5 per cent, right salpingectomy was done in 63 or 11.5 per cent, left salpingectomy was done in 48 or 8.8 per cent.

Smears and cultures taken from the tubes were positive for gonococci in only seven instances. Staphylococcus was found in two, and

streptococcus in one. The remaining cases in which smears were taken were sterile. In many, smears were not taken. According to Ricci, 'Gonorrhœa of the fallopian tubes is a self limiting disease. It produces but one attack of pain, fever, and leucocytosis—the initial one. When subsequent attacks occur and adnexal masses are palpable the gonococcus has yielded its endosalpingeal habitat to secondary bacterial invasions.'

Hydrosalpinx was found thirty times. By *hydrosalpinx* is meant the final stage in the chronic process in which absorption of the contents has gone on to such a degree that only a watery material remains, enclosed in a sac formed by the walls of the tube and its blocked extremities. The similar primary acute pathology such as is seen in hydrops of the gall bladder probably does not occur with the salpinges. Hematosalpinx, which is the acute hæmorrhagic form, was found three times. In these two classes of cases all smears and cultures were sterile.

Three hundred twenty two or 74.5 per cent were closed without drainage. Most of them remained clean. Abdominal wall abscesses occurred in a few. In 89 or 20.5 per cent, abdominal drainage was used, in 22 or 5 per cent, vaginal drainage (posterior colpotomy).

A few words may be said here as to the advisability of drainage. Fewer cases are being drained now than in former years. This is a definite step in advance in the surgery of salpingitis. It is rarely found that a case that has not been drained should have been. This is probably due to the fact that the pus has become sterile. The infection has worn itself out. Therefore, it is only necessary to remove the pathological process, or as Miller (3) puts it, "The patient forms her own immunity." Thus, the percentage of negative cultures increases in direct ratio to the length of time the case has "cooled." Especially have the views on posterior colpotomy changed. It is now considered very seldom to be a good procedure, and is only indicated, without laparotomy, in cases presenting a huge well defined pelvic abscess. It is indicated after laparotomy, when much pelvic exudate is present.

*Disease other than of the fallopian tubes*  
(1) Involvement of the ovaries. The right

ovary was found to be diseased and was removed in 160 cases, the left also in 160. A partial oophorectomy was done in 42 cases. An attempt was made to save all of the ovarian tissue possible in order to prevent the onset of an artificial menopause. The proper procedure is to leave in all of the ovarian tissue that is not definitely grossly diseased. (2) Involvement of the appendix. Appendectomy was done in 287 cases, as will be subsequently described. (3) Other operations were: Dilatation and curettage in 71 cases for endometritis or retained secundines; hysterectomy in 29, either for infection or fibromyomata; myomectomy in 13, uterine suspension for retroversion in 52, freeing of adhesions in 11, excision of cyst of broad ligament in 2, replacement of prolapsed ovary in 2, excision of peritoneal cyst in 1, excision of cysts of the ovary in 2, in which the cysts contained grape juice like material typical of tuberculosis of the ovary, trachelorrhaphy in 4, perineorrhaphy in 6, repair of lacerations of the cervix in 1, excision of Bartholin's abscess in 1, amputation of the cervix in 1, excision of perineal fistula in 1, cholecystostomy in 1, cholecystectomy in 4, exploratory laparotomy finding no disease in 1, repair of perforations of the cæcum in 2, hæmorrhoidectomy in 1, freeing of Lane's kink in 1, bladder suspension in 1, incision and drainage of hæmatoma of back in 1, suture of lacerated wound of the ureter in 1, nephrectomy in 1, herniorrhaphy in 1.

#### WHEN TO OPERATE

The judgment of the surgeon in the individual case being of prime importance, rules cannot always be followed in surgery. However, it is well to have certain general views on the different types of cases. Some of the modern recognized views on the surgical indications of salpingitis are as follows:

1. Acute cases should never be operated upon. Of course, this rule has its exceptions, the most important of which is—doubt in diagnosis. The doubt is usually concerned with acute appendicitis. It certainly is far better to operate upon a few cases of salpingitis in the acute stage than to allow an acute appendix to rupture, with general peritonitis or even death as the result.

2 Even an acute fulminating salpingitis with general peritonitis should not be operated upon if the diagnosis is reasonably certain. In the New York Hospital series, these cases subsided without operation. Operation frequently causes spread of the peritonitis, resulting in death.

3 When there is a reasonable doubt between salpingitis and appendicitis in the acute form, operation should be advised, because there is too much danger in delaying or not operating upon an acute appendix.

4 When the abdomen is opened on another diagnosis and acute salpingitis is found, it is usually advisable to remove the tubes, except in young girls. This may seem reactionary, but experience teaches that if these acute tubes are removed, there are usually no untoward effects. On the other hand, however, if they are not removed and if they do subside, they are very liable to recur or become reinfect.

5 Patients, during an acute exacerbation, should not be operated upon, as an operation is very liable to spread the infection to the surrounding tissues and to the peritoneum. The exacerbation should be allowed to subside and the operation should not be performed until after the temperature has been normal for about 5 days. It is usually advisable to operate after the 5 days of normal temperature and while they are still in the hospital. For if they are allowed to go home with instructions to return later for operation, they are too prone to wait until another exacerbation occurs when the whole procedure would have to be repeated.

6 In chronic salpingitis the tubes should be removed if they are not patent. If patent, removal is not advisable unless the tubes are definitely giving rise to symptoms.

7 Tubes in acute and acute exacerbation salpingitis of tuberculous nature should be allowed to subside. Chronic tuberculous tubes should not be operated upon until every other therapeutic measure has been given a fair trial.

8 All ovarian tissue not definitely grossly diseased should be left in. Partial oophorectomy was frequent in this series of cases.

Good judgment was shown in operating on 185 chronic cases. Of the acute variety, 48

were operated upon, which might have subsided. Theoretically, in the latter, it was incorrect to operate. In many of the cases, the tubes were removed but in quite a few, after the mistake in diagnosis was recognized, the abdomen was closed without disturbing the tubes. In all of the latter cases, the inflammation subsided. Thirty three which were operated upon during an acute exacerbation should have been allowed to subside. Correct procedure was followed in 16 cases of acute exacerbations, no operation being performed until the exacerbation had subsided. There were 48 cases of the acute variety which subsided without operation, the treatment consisting of rest in bed, ice bags, hot douches, etc. Fifty nine were operated upon following other diagnoses, but as chronically diseased tubes were found, it proved to be the proper procedure. Forty three were operated upon following other diagnoses and in many instances, either acute or acute exacerbation tubes were found and removed. Of the tuberculous variety, 19 were diagnosed chronic salpingitis, rather than tuberculous. These were operated upon—a theoretically incorrect procedure. Three tuberculous acute exacerbations were also incorrectly operated upon, one acute case was treated medically. Thirty eight persons, most of them being chronic cases, were advised to have operative treatment but refused.

There has been considerable controversy during the past few years as to the proper time of operation. The trend has definitely been toward conservatism ever since Simpson's article in 1909 in which he put forth his excellent principles of treatment. It is said that he reduced the death rate in a large series of cases from 20 per cent to 1 per cent by operating only upon quiescent cases, after 3 weeks or more of normal temperature and leucocyte count.

Miller, in his recent article brings out some interesting observations from his study of 600 cases in the Charity Hospital and the Touro Infirmary of New Orleans. He found that in 381 of the 600 conservative treatment was not carried out, that is they were operated upon in the presence of fever. He also found that 70 per cent with rest treatment alone

reached a permanent normal temperature in a week or 10 days

Ricci advocates a waiting period of over 3 weeks, as he found that some cases operated upon even after the 3 weeks did poorly. He even goes so far as to say "Patients with pelvic masses harboring organisms of various types, the streptococcus included, may, from an economic point of view, be below par, but they are never totally incapacitated except during an acute exacerbation. As time goes on, the interval between the attacks increases and the severity diminishes."

*Contra indications to operation* In the New York Hospital series, there were 4 patients in whom the symptoms and physical signs were too indefinite to justify surgical treatment: pregnancy in 3, cardiac disease in 3, mental disease in 2, epilepsy in 1, lactation in 1, aortic aneurism in 1.

*Pre operative time in the hospital* The pre operative time in the hospital varied between a few hours and 30 days, the average being 22 days. Most of these series were studied for 1 or 2 days before operation. Some were observed for several days, either due to doubt in diagnosis, lack of consent of the patient or until an acute exacerbation had subsided. Salpingitis should always be an operation of election, not of necessity, that is, not an emergency unless there is considerable doubt in the diagnosis, the doubtful disease being an emergency.

*Postoperative time in hospital* The time spent in the hospital after operation varied between 1 and 92 days, the average being 15.3 days. In an ordinary, uncomplicated clean case, the patient was allowed out of bed on the eighth or ninth day and was discharged on the tenth or eleventh postoperative day. Drainage cases, cases developing abdominal wall abscesses, and other complications were the causes of prolonged hospitalization.

Miller found that early operation caused more postoperative complications. Of the 83 patients in his series of 600 who developed postoperative complications, 59 or nearly 72 per cent had not been sufficiently cooled. The same conclusions were arrived at in the patients running a postoperative elevation of temperature.

## SECONDARY OPERATIONS WHILE IN HOSPITAL

There were 22 secondary operations, this being 5 per cent of cases: posterior colpotomy for secondary pelvic abscesses in 5 cases; laparotomy for secondary pelvic abscesses in 3; laparotomy following posterior colpotomy in 2; laparotomy following dilatation and curettage in 1, for intestinal obstruction in 1, for ectopic pregnancy in 1, incision and drainage of wound abscess in 2, incision and drainage of hæmatoma of back in 1, dilatation and curettage in 1, repair of immediate postoperative hernia in 1, for fecal fistula in 1; nephrectomy in 1, incision and drainage of axillary abscess in 1, for duodenal ulcer in 1.

The foregoing is of no especial importance except to show that secondary pelvic abscesses occurred in 8 cases, and that other important surgical procedures are sometimes necessary while patients are recovering from salpingectomy. This is another argument in favor of having the general surgeon treat salpingitis as well as the gynecologic surgeon.

## POSTOPERATIVE INTESTINAL OBSTRUCTION

There were only two cases of intestinal obstruction following operation, one caused death, the other was cured.

## POSTOPERATIVE INCISIONAL HERNIA

There were 13 ventral hernias reported following operation, making 2.96 per cent of cases. The time these occurred or were reported varied from 1 month to 7 years, the average being 22 months, 9 of the hernias followed operations in which abdominal drainage had been used. The remaining 4 had had no abdominal drainage, 1 case was complicated by syphilis and 3 by general peritonitis. In one of the latter 4 cases, the hernia was repaired 4 months after operation, but recurred a year later. This was an acute case in which bilateral salpingectomy and appendectomy had been made with no drainage. In another, an acute exacerbation, there had been two laparotomies 8 months apart, both with drainage, and not until 9 months after the second operation did the hernia occur.

## MORBIDITY

The hospital morbidity ranged between 1 and 92 days, the average being 15 1 days

## MORTALITY

In our series, 15 deaths occurred, making a general mortality rate of 2 75 per cent, and a postoperative mortality rate of 3 42 per cent. There were 127 patients operated upon during active infection. This was 29 per cent of the cases operated upon and 23 3 per cent of the cases admitted. Twelve of the 15 deaths were in patients who had been operated upon during active infection, thus there was a mortality rate of 9 45 per cent in cases operated upon during active infection or before they had "cooled."

In Miller's series of 600 cases, there were 18 or 3 per cent of deaths, 16 of these were operated upon early.

Ricci, in reviewing 600 cases at the Metropolitan and City Hospitals, New York City, finds a much higher death rate. He divides his cases as follows: (1) non operated upon no mortality, (2) non infective chronic cases, operated upon 0 05 per cent mortality, (3) purulent acute and chronic cases operated upon 14 5 per cent mortality. Also, he does not include in his mortality rates deaths from causes such as "embolic processes, intestinal injuries, cardiac failures, and other pneumonias."

All of the deaths in our series were postoperative, the causes being 9 from general peritonitis, 4 were sudden deaths on the operating table, 1 of intestinal obstruction, 1 of acute dilatation of the stomach, 1 of a cerebral accident, 1 of lung abscess.

A short resume of all of the cases that died in the hospital following operation is given, the nature of the case, the cause of death, complications, mistakes etc.

**CASE 1** D D aged 26 years admitted to hospital June 3 1925, with the diagnosis of cystoma of the ovary, complications—chronic appendicitis and abortion operation—appendectomy and excision of cyst. Patient was discharged apparently cured. On June 25 1925 she was readmitted with a history of severe deep pain in the lower right quadrant for the past 4 days associated with vomiting dysuria and vaginal discharge. Examination showed bilateral abdominal tenderness and rigidity, more marked on

the right side, temperature 103 degrees, leucocytes 20,200 with 90 per cent polymorphonuclears. The patient was very ill and was operated upon the day after admission. Bilateral salpingitis with pelvic abscess which had perforated into the cecum was found. The tubes were removed, the abscess was drained, and the perforated cecum was repaired. Patient died suddenly on the operating table of ether narcosis or pulmonary embolism.

This patient should probably not have been operated upon, as it was an acute fulminating case.

**CASE 2** M C aged 46 years, admitted to hospital July 25 1926, with pain in the epigastrium and lower right quadrant for 16 days, no vomiting, indefinite tenderness and mass in the lower right quadrant but no rigidity, temperature 104 degrees F, leucocytes 20,000 with 90 per cent polymorphonuclears. The diagnosis was difficult, the factors in the differentiation being fibroid uterus with partial intestinal obstruction and cystitis. Panhysterectomy was done for acute exacerbation, tubes, oophoritis and fibroid uterus a few hours after admission. Patient died suddenly on the operating table—cause unknown but probably cardiac weakness from prolonged sepsis.

This was a case of acute exacerbation and should have been allowed to subside, the cause for the immediate operation was doubt in diagnosis.

**CASE 3** A T S aged 60 years admitted to hospital December 6 1926 with a history of cramp like pain in the abdomen for 8 days, with vomiting. Abdominal examination showed generalized tenderness and rigidity, vaginal examination showed tenderness in both fornices, temperature was 99 degrees, leucocytes 7,120 with 87 per cent polymorphonuclears. Incorrectly diagnosed as intestinal obstruction and the patient was operated upon 2 days later. This was really an acute case of salpingitis and should have been allowed to subside. Pelvic abscess with general peritonitis was found on operation. Right salpingectomy and posterior colpotomy were done. The patient lived 30 days.

In this case, both the temperature and the leucocytes were low, even in the presence of general peritonitis. Thus, with the fact that the patient did not react well to operation and did not improve, shows that there was very poor resistance on the part of the patient.

**CASE 4** M A aged 49 years admitted to hospital March 17 1925 with a history of an attack of lower left abdominal pain 6 months previously followed by irregular menstruation. Abdominal examination showed slight tenderness in the left lower



quadrant, vaginal examination showed an enlarged uterus pushed to the right by a large mass in the left fornix temperature 100 degrees, leucocytes 12,000 with 88 per cent polymorphonuclears. A mistaken diagnosis of uterine fibroid was made and a few hours after admission a panhysterectomy was done for chronic salpingitis and chronic endometritis. After the operation the patient seemed to have no resistance and developed general peritonitis with partial intestinal obstruction for which a jejunostomy was done on the second postoperative day. Following this there was no improvement the patient dying on the fifth postoperative day.

CASE 5 D V aged 24 years admitted to hospital March 13 1927 and died the following day. Patient complained of pain in the lower abdomen with a history of painful abdominal attacks for the past 2 years. She had never been acutely ill. There was no nausea or vomiting. The attacks were aggravated by exertion such as bending over. Recently there had been little or no pain but as the patient had never been pregnant and wished to have children she came to the hospital for advice. Examination of the abdomen was negative, vaginal examination showed bilateral tender masses temperature 100 degrees, a bilateral salpingectomy and appendectomy were done. The pathological report showed the process to be chronic tuberculosis of both tubes. The patient died on the operating table of ether narcosis.

CASE 6 C G aged 32 years admitted to hospital August 6 1927 died 4 days later. Onset with pain in the abdomen said to have followed trauma the latter being preceded by pain in the back. Examination showed tenderness in the lower right quadrant enlarged right ovary and tenderness in both vaginal fornices temperature 99 degrees leucocytes 6,400 with 77 per cent polymorphonuclears. The diagnosis was difficult anteflexion and anteversion of the uterus and acute appendicitis being excluded. The patient was operated upon the day after admission a bilateral salpingectomy left oophorectomy, and appendectomy being done. Recovery was apparently uneventful when some cerebral accident occurred on the fourth postoperative day, causing death.

CASE 7 K S, aged 46 years admitted to hospital December 3 1914 complaining of sticking pains in the right lumbar region. According to the history, the onset of sticking pains in this location occurred 2 months previously was moderately severe in character, and was associated with chills and fever. Pain was worse a few days before each menstrual period radiated to the lower right quadrant and was aggravated by respiration. Appetite had been poor but there had been no nausea or vomiting had been in bed off and on depending on the severity of the pain. A few days just prior to admission the patient had noticed tenderness in the lower right quadrant. Abdominal examination was practically negative. Vaginal examination showed a bloody uterine discharge and tenderness of the cervix and both fornices. Temperature 98.2 degrees. Conditions considered in the differential diagnosis besides salpingitis were

acute appendicitis ovarian cyst with twisted pedicle ruptured ovarian cyst. No definite diagnosis was made before operation. A dilatation and curettage were done showing evidence of chronic endometritis. There was no improvement. The symptoms and signs persisted and the general condition became worse general peritonitis setting in so an exploratory laparotomy was decided upon. The left broad ligament was the seat of a large globular swelling cystic in character but when ruptured was found to contain pus. The patient did not react to the operation and died in a few hours of general peritonitis.

Although it was impossible to make a definite diagnosis in this case, a mistake was made in operating because it was an acute exacerbation which had a better chance of subsiding without operation. This is a typical case of fulminating acute exacerbation with general peritonitis.

CASE 8 L N, aged 23 years admitted to hospital November 22 1915 and died 8 days later. History of irregular menstruation, dysmenorrhoea, dysuria, backache and vaginal discharge. Examination showed bilateral tenderness and a vaginal discharge temperature 98.4 degrees. It was a chronic case easily diagnosed. The patient was operated upon 2 days after admission—bilateral salpingectomy, hydro-salpinx, left oophorectomy and appendectomy being done without drainage. Soon after operation, she developed acute generalized streptococcus peritonitis. Abdominal drainage was instituted on the fifth postoperative day but the patient died the next day because of the fulminating infection.

It is difficult to see how there could have been any anticipation or prevention in this case.

CASE 9 L S aged 25 years admitted to hospital May 21 1916 and died July 3 1916. History for the previous year was of irregular menstruation and dysmenorrhoea for the past 5 days headache, chilliness and pain in the back and legs. Examination showed tenderness and rigidity in the left lower quadrant temperature 101.2 degrees leucocytes 20,000 with 88 per cent polymorphonuclears. The diagnosis was difficult typhoid fever and migraine being excluded. The patient was operated upon 3 days after admission—bilateral salpingectomy and left oophorectomy without drainage being done for an acute exacerbation process. The exacerbation should have been allowed to subside before operation. The patient lived for 11 days after operation. Death was caused by complications which developed after operation acute dilatation of the stomach, general peritonitis, pleurisy, atelectasis, and hematoma of the back.

CASE 10 R D aged 31 years admitted to hospital April 9, 1920, and died 2 days later. The his-

tory disclosed pain in the lower left quadrant and back following delivery 1 month previously, also urinary frequency and vaginal discharge. Abdominal examination showed a tender mass in the lower left quadrant. Vaginal examination showed a mass in the left fornix. Temperature 98.8 degrees. The diagnosis was difficult—dermoid cyst of the ovary being considered and so diagnosed. Patient was operated upon the day after admission a left salpingo-oophorectomy without drainage being done for an acute exacerbation process which should have been allowed to subside. The pelvic peritonitis which was present spread rapidly and the general condition of the patient became progressively worse. She died the following day.

CASE 11. E. L., aged 22 years, admitted to hospital May 14, 1920 and died June 4, 1920. She complained of cramp like pain in the epigastrium vomiting and belching of gas. The history was that 6 days previously she had had a slight epigastric disturbance following the evening meal and vomited a small quantity of foul smelling material 3 days before admission she had a chill with fever took magnesia and vomited but had no pain at that time. The following day she was able to get up and did some work. Three days before admission she had another severe chill with fever and went to bed also had a sore throat vomited again and eructated gas. The next day the temperature remained high belching continued and on the morning of admission she complained of sharp cramp like pain in the epigastrium radiating to the middle of the back, and again vomited. She gave a history of previous attacks of indigestion but no similar attacks. Abdominal examination showed slight tenderness in the epigastrium none elsewhere. Vaginal examination showed a moderate discharge but no tenderness. Temperature 103.2 degrees leucocytes 16,000 with 88 per cent polymorphonuclears. The temperature remained very high for the next 20 days running a septic course. Due to progressive weakness and toxicity of the patient an exploratory laparotomy was done. Acute pyogenic infection of the left tube and ovary with pelvic peritonitis, peri sigmoiditis, and peri appendicitis were found. A left salpingo-oophorectomy and an appendectomy were done. Culture from the ovary which was removed showed a pure growth of hemolytic streptococcus. The patient reacted poorly to the operation the temperature rising to 106 degrees. She died 18 hours later.

This was an acute case and should have been allowed to subside without operation.

CASE 12. L. J., aged 44 years, admitted to hospital December 8, 1920 and died the next day. History revealed irregular menstruation and bilateral pain more severe in the lower right quadrant. Labial herpes, hiccoughs, vomiting, fever and headache. Examination showed distention of the abdomen and generalized tenderness and rigidity in the lower right quadrant, both fornices were tender more so on the

right. No diagnosis was made. The following conditions besides salpingitis were considered: acute appendicitis, ovarian cyst with twisted pedicle, pneumococcus peritonitis, acute diverticulitis, and ruptured ectopic pregnancy. Temperature on admission was 101.2 degrees leucocytes 27,200 with 89 per cent polymorphonuclears. Patient was operated upon after a few hours an acute exacerbation salpingitis, appendicitis and general peritonitis being found. The appendix was removed and the peritoneum drained but the peritonitis was so fulminating that the patient died on the following day.

This case might have subsided if left alone. However, the lack of a definite diagnosis justified the operative procedure.

CASE 13. J. G., aged 27 years, admitted to hospital November 30, 1923 and died January 3, 1924. History of 5 weeks of pain in the lower right quadrant with vaginal discharge. Examination showed tenderness in the lower left quadrant and in the right fornix. Temperature 99 degrees leucocytes 8,400 with 76 per cent polymorphonuclears. Patient was operated upon the day after admission—bilateral salpingo-oophorectomy being done for chronic disease. With the exception of an abdominal wall abscess patient was recovering satisfactorily from the operation. Some time later a lung abscess developed. Patient was again operated upon, but died on the fourth postoperative day.

CASE 14. M. C., aged 20 years, admitted to hospital June 20, 1923 and died the next day. History of 3 weeks of sharp pain in the left lower quadrant and legs, nausea, vomiting, fever and irregular menstruation. Examination showed tenderness and rigidity in the lower right quadrant, vaginal discharge, and a tender mass in the left fornix. Temperature 103.6 degrees leucocytes 13,900 with 67 per cent polymorphonuclears. Acute salpingitis was diagnosed. Pelvic abscess also being considered. Left salpingo-oophorectomy was done the day after admission which showed the process as being acute tuberculosis of both tubes and ovaries, more advanced on the left side. The patient died a few hours later of surgical shock.

As this was definitely an acute case, it should have been allowed to subside without operation.

#### FOLLOW UP

A very careful attempt at following up the patients was made. Many of them were appreciative and co-operative. On the other hand, a great many never returned some of them having moved away, and probably many of them not wishing to advertise their condition further.

Twenty or 3.6 per cent of cases were operated upon too recently to obtain follow up.

records, 98 or 17.9 per cent were not traceable and nothing was found out or heard concerning them, 69 or 12.6 per cent were readmitted for similar or different conditions, in 57 or 10.4 per cent no follow up records were made, either because they were unco-operative or for some other reason.

There were 20 or 3.6 per cent that returned and were considered unsatisfactory, most of these on their original admission had had an acute salpingitis which subsided, but later recurred. Some of them were cases in which one tube had been removed, there being subsequent involvement of the other tube. The time of recurrence ranged between 3 months and 2 years, the average time being  $7\frac{1}{2}$  months.

The latest theory is that if the infection is gonorrhoeal, the so called recurrences are not recurrences at all but are new infections introduced from without.

Two hundred five or 37.9 per cent were considered satisfactory and presented themselves with no complaints, the time after operation for these determinations ranged between 1 month and 12 years, the average being  $9\frac{1}{2}$  months. These records were made on determinations as follows, the time given being the last time that the patient reported: 1 month, 2 cases, 2 months, 12, 3 months, 90, 4 months, 40, 5 months, 14, 6 months, 16, 7 months, 5, 8 months, 1, 1 year, 3, 1 year and 6 months, 2, 2 years, 3, 2 years and 6 months, 2, 3 years, 4, 4 years, 1, 5 years, 2, 6 years and 6 months, 1, 7 years, 1, 8 years, 1, 9 years, 1, 10 years, 2, 12 years, 1.

There were 110 or 20.1 per cent considered satisfactory but with complaints, the time after operation for these determinations ranged between 1 month and 5 years, the average time being 6.6 months. The times considered were: 1 month, 1 case, 2 months, 5, 3 months, 45, 4 months, 14, 5 months, 12, 6 months, 7, 8 months, 4, 9 months, 4, 10 months, 2, 11 months, 2, 1 year, 4, 1 year and 6 months, 2, 2 years, 4, 4 years, 1, 5 years, 3.

#### RESULTS

Three hundred fifty six or 65.3 per cent of cases left the hospital as cured; that is, there was little probability that they would have

further trouble. 131 or 24 per cent left the hospital as improved, 37 or 6.78 per cent left as unimproved, 38 or 6.9 per cent left against advice—untreated, 14 or 2.5 per cent died in the hospital, there were records of the subsequent deaths of only 3 or 0.5 per cent of cases.

Of the results that were considered unsatisfactory, some of the patients' complaints on return were pain and tenderness in the lower right quadrant, and tenderness in the right fornix, tenderness in the lower abdominal foul vaginal discharge, loss of weight and epigastric pain, pain and hard tender mass in pelvis, pain in lower left quadrant, pain in abdomen, vaginal discharge, urinary frequency, and dysuria, pain in the left side mass in the lower right quadrant and in the right fornix.

The cases that were considered satisfactory but had complaints were: irregular menstruation in 5 cases, excessive menstruation in 2, dysmenorrhoea in 5, amenorrhoea in 4, scanty menstruation in 1. Pain was complained of as occasional in 12 cases, in the back in 10, in the left groin and backache in 1, incisional in 7, indefinite in 12, persistent in the left side in 3, in the lower right quadrant in 4, dragging in 1, abdominal, unclassified in 4, in the upper abdomen in 2.

Symptoms of ovarian dysfunction or artificial menopause were found in 8 cases as listed below. This is an important determination to make and a factor that must be watched carefully after pelvic operations.

1. Eleven months after hysterectomy and left oophorectomy and salpingectomy for an acute exacerbation process, the patient complained of menopause symptoms and was given ovarian extract with satisfactory results.

2. Three months after bilateral salpingo-oophorectomy, the patient had hot flashes, nervousness, and palpitation.

3. Three months after bilateral salpingectomy and left oophorectomy, uterine suspension, and perinorrhaphy, the patient complained of faintness, amenorrhoea and leucorrhoea.

4. Three months after right salpingo-oophorectomy, the patient complained of hot flashes and amenorrhoea.

5 Five months after left salpingo oophorectomy, appendectomy, and cholecystectomy, the patient complained of amenorrhœa and dyspareunia

6 Three months after bilateral salpingo oophorectomy, the patient had dysmenorrhœa and leucorrhœa

7 Ten months after left salpingo oophorectomy and appendectomy the patient's condition was unsatisfactory due to menopause symptoms

8 One year after panhysterectomy, the patient complained of amenorrhœa

Besides these, there were some leucorrhœa in 10 cases, foul vaginal discharge in 7, slight tenderness in both fornices in 1, abdominal and rectovaginal fistulæ in 1, dysuria in 4, tender cystic ovary in 1, irregular menstruation with pain in the lower left quadrant in 1, weakness of incision in 1, ventral hernia in 13, hard mass in right fornix in 1, discharging abdominal sinus in 1

Other complaints and conditions found were Symptoms of early pregnancy in 8 cases, indigestion in 3, also hæmorrhoids, rheumatism, morning nausea, constitutional psychopathy, hysteria, neurasthenia, pregnancy and syphilis, fibroids, constipation, cough and vomiting, bleeding from rectum, tuberculous arthritis, pulmonary tuberculosis, dyspareunia, headaches, prolapsed uterus, obesity, nervousness, and slight elevation of temperature

The diagnoses of the patients readmitted were Salpingitis in 15 cases, inguinal adenitis in 1, laceration of the cervix with secondary hæmorrhage in 1, fæcal fistula in 1, fibromyoma of the uterus in 5, constitutional psychopathy in 1, ectopic gestation in 4, ventral hernia in 10, cystic ovary in 5, Bartholin's abscess in 2, retroversion of the uterus with adhesions in 1, retroversion of the uterus in 1, chronic endometritis in 2 postoperative adhesions in 2, chronic appendicitis in 4, miscarriage in 2. And one case each of the following conditions Relaxation of the perineum, prolapse of the uterus, acute gastritis, acute dilatation of the stomach, hæmorrhoids, fistula *in ano*, cellulitis of abdominal wound, cholecystitis, intestinal hæmorrhage, syphilis, arthritis of the knee, duodenal ulcer, tubercu-

losis of the vertebræ with psoas abscess, and tuberculous peritonitis

Note the nature of the original operation in some of the previously mentioned 15 patients that were readmitted with the diagnosis of salpingitis

1 Three months following right salpingectomy, appendectomy, and dilatation and curettage, the patient's condition was unsatisfactory, complaints being loss of weight and epigastric pain Examination showed an enlarged boggy uterus

2 Four months following right salpingo oophorectomy and appendectomy, the result was unsatisfactory the patient complaining of pain A hard tender mass was found to the left of the uterus

3 Five years after right salpingo oophorectomy, the patient had an acute left salpingitis left salpingo oophorectomy was done

4 One month after right salpingectomy and appendectomy the patient had a large tender left tube which subsided

5 Five years after right salpingo oophorectomy and appendectomy the patient had left salpingitis acute exacerbation and left salpingo oophorectomy was done

6 Eight months after left salpingectomy and appendectomy the patient was readmitted with acute pelvic peritonitis which subsided without operation

7 Four months after right salpingo oophorectomy and appendectomy the condition was unsatisfactory the patient complaining of pain in the lower left quadrant and dysmenorrhœa an enlarged tender prolapsed ovary was found on examination The patient refused operation

8 Seven months after right salpingectomy, the condition was unsatisfactory, the patient complaining of pain in the left side and vaginal discharge Examination showed a marked exfoliative vaginitis

9 Four years after left salpingo oophorectomy the patient was readmitted with chronic right salpingitis and postoperative adhesions Right salpingectomy appendectomy, and freeing of the adhesions was done

10 One year and 6 months after right salpingo oophorectomy and appendectomy, the condition was unsatisfactory and left salpingo oophorectomy was done

11 Four months after right salpingectomy and appendectomy the condition was unsatisfactory and the patient complained of pain in the back and in both sides and nervousness

12 Four months after partial right salpingectomy, right oophorectomy uterine suspension etc the condition was unsatisfactory, the patient complaining of profuse vaginal discharge headache pain in the back and dysmenorrhœa

No definite data could be found in regard to whether or not it is advisable to do conservative surgery in diseased tubes, that is,

whether partial salpingectomy and plastic operations are worth while

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STATISTICAL REPORT OF CAUTERY SURGERY IN UTERINE CARCINOMA<sup>1</sup>

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In this city thirteen years ago (1915) in an address<sup>2</sup> before the Clinical Congress of Surgeons, I said in part "It is only fair to state that when I publish the statistics of my first one hundred cases (of cautery surgery in uterine carcinoma) the results in the advanced patients are not going to be such as to arouse enthusiasm on the part of many surgeons, much of this will be due to the fact that I have been exploring a practically unknown field risking too much, perchance, but always with the hope that if I could destroy the gross mass (of pelvic carcinoma with heat), the patient's assumed natural defensive forces would care for the implied present or future metastases. With increasing knowledge of what can be done in this way with the other wise utterly inoperable, often terminal, third stage cancer patient by the application of heat, entirely eliminating the cold knife, by better judgment and operative technique, combined with added experience in their management both pre and postoperative, possibly by employing a two stage cautery knife procedure, and perhaps following this with the limit of normal tissue toleration of radio active agents I know that a degree of palliation can be obtained in all and a live or more years respite or cure in many, that is well worth while."

My first cervical cancer patient was treated with soldering irons September 22, 1903 twenty five years ago. The abdomen was not opened. The irons were heated to a cherry red color and plunged into the mass through an asbestos covered vaginal speculum and kept there until the cautery stopped simmering in the involved tissues. This was repeated, often many times until it was judged that the malignancy in the cervix uterocervical junction or body of the uterus was thoroughly destroyed. It was assumed that this was accomplished when tissue structures normally

movable but fixed by the pathology were made normally movable again by the heat applications. The patient lived 1 year and 7 months (1) and died from toxæmia incident to local recurrence of her primary trouble. This possibly crude, but not always unavailing, cautery method was made more rational in 1914 as a definite surgical procedure when I opened the abdomen preliminary to the application of an electrically heated cautery, in place of the soldering iron, to cervical and uterine body carcinoma. The first patient (Mrs E H W, Table I) in whom I employed this technique for the safer and definitely more effective cautery destruction of cervical cancer, required two rather widely separated applications of the method. Her pre operative history, preliminary to the first cautery application, concerns a "profuse, bloody, watery very offensive vaginal discharge for over one year, with pain extending down the right thigh as far as the knee, and a harassing cystitis. Nocturia three to four times, at which times she required fresh pads because of the vaginal flow. The entire cervix was found occupied by an exuberant cauliflower-like mass." The postoperative history of the first cautery treatment August 2, 1912, was completely satisfactory for 2 years and 4 months, when she returned with an extensive recurrence of cancer in the body of the uterus. It was at the second operation (November 27, 1914) that her abdomen was opened for the treatment of the recurrence and cautery excision of the uterus employed intra abdominally. This is, as far as I have been able to discover, the first time that the abdomen was ever opened for the complete removal of vaginal, cervical, or uterine cancer by the cautery knife, or for the infiltration of a destructive degree of heat into the uterus from the vaginal side both of which were practiced in this woman's pelvic cancer. It will add interest and value to this report on the heat method to state that this patient is alive

<sup>1</sup>Read at the 12th annual meeting of the American Society of Gynecology and Obstetrics, 1916, June 17-19.

<sup>2</sup>Presented in the Cancer Symposium at the meeting of the Clinical Congress of Surgeons of North America, Boston, October 8-12, 1928.

and well 16 years and 2 months following the first application of cautery heat to her spreading carcinoma of the cervix, and 13 years and 10 months following the second operation (1914) when the abdomen was opened and her uterine body carcinoma (together with what was left from the original vaginal cauterization of the uterocervical junction and vault of the vagina) removed abdominally with the cautery knife.<sup>1</sup> It should also be stated that at the second operation there was no physical evidence, either in the vault or walls of the vagina, of carcinoma left over following the first application of the cautery heat. If this were the only favorable experience I have had following the employment of my technique in both early and late extensive pelvic cancer, it would not be noted as of more than passing significance.

This report is based on a total of 134 patients here referred to generically as suffering from cervical carcinoma. My first patient with this condition, I repeat, was cauterized in 1903. I have included no patient who was treated later than October, 1925. Because of interruptions incident to the Great War, I did no pelvic cancer surgery from January, 1918, to January, 1923—5 years. For the purposes of this report this permits the division of the cautery treatment of my pelvic cancer patients into two periods. The first comprising 28 private patients treated with the cautery between 1903 and all the months of 1917, and the second period from early in 1918 to October 1925. The patients treated in this second period (1918-1925) can be classified into private and institutional, of which there were 23 of the first and 83 of the second. In the first period (1903-1917) all of the patients were private. The private patients combined in the two periods total 51. This number, added to the 83 treated in institutions accounts again for the total of 134 patients. In the first period, with 28 patients 9 are alive and well (32 per cent) from 9 to 19 years.

Of the practically unselected institutional cases, 83 in number 54 can be classed as palliative, for the reason that they had developed

one or more of the characteristic outstanding features of recurring cancer, viz hemorrhage, foul discharge, cachexia, frozen pelvis and pain, not to mention additional distressing marks distinctive of the advanced pelvic cancer patient demanding relief. Forty-four of these lived, following attempts at palliation with the cautery, from one day to 2 years and 7 months. The remaining 10 of the 54 (2 of which were recurring cases) are at present untraced 15 days to 1 year and 5 months following operation. Six of the 83 mentioned above were given radio active treatments and all are dead. Three died in 4 days following the completion of their treatments, one in 14 days, one in 3 months and one in 1 year. This latter patient, in addition to the radio active agents, had three intravenous infusions of colloidal copper ("Cuprase"). The remaining 23 of the 83 were straight cautery cases, i.e., they were primarily and only treated with the cautery. Of these, 12 lived from 2 days to 1 year and 4 months after its employment, as follows: one lived 2 days, one, 3 days, three, 5 days. In one of the five both ureters were damaged. One patient lived 14 days and died of peritonitis, one lived 17 days, one, 4 months, one, a year, three, 1 year and 4 months. Eleven of the 23 patients are alive and well after the 3 year period (48 per cent). Seven have passed the 4 year period (30 per cent), and 3 have reached the 5 year period (13 per cent). Therefore 27 in the total of 134 patients are alive and well from 3 to 19 years. This gives, in all of the cases for all of the years between 1903 and 1925, an average of good results of 20 per cent. It will be noted however, that 2 of these cautery operated upon patients are alive and well just over the 3 year limit, and as most of us know, the third year is the graveyard of great numbers of cancer statistics. One of the remaining 3 year symptom free patients was operated upon November 1923 and is untraced after entering the fourth year, while 2 have entered safely into the second half of the fourth year.

The pathology in these 27 symptom free cases was reported by the laboratories as follows: Squamous cell carcinoma, 16 cases, adenocarcinoma, 6 cases, and carcinoma 5 cases.

<sup>1</sup>In a footnote in a former paper (Am J Obst Gynec, v 1, p 33) it was erroneously stated that I first opened the abdomen in the more than 40 cases noted in this report in pelvic carcinoma August 1913. The correct date as stated above was November 27, 1914.





process, requiring cautery resection of fully 2 inches (5 cm), or more, of the viscus, and of 1 inch (2.5 cm) of the distal portion of the ureter, and its reimplantation into the repaired bladder. In addition there were enlarged hard glands at the bifurcation of the iliac arteries which were pronounced adenocarcinomatous by the laboratory of the Los Angeles General Hospital (4). More than this, it was necessary to cautery dissect about 5 inches (13 cm) of the rectal sigmoid from the pelvic mass before it was possible to remove the uterus, adnexa and upper third of the vagina. This woman was 48 years of age at the time of her operation and has since married.

In this connection it will also be of interest to refer to (Table II), Mrs. J. C. R., whose abnormal pelvic history dated back fully two years when she was sent in by Dr. Harry J. Willey, Porterville, California, as having a probable "inoperable" cervical carcinoma. Her history when she first presented herself had the following relative to her pelvis: "A large firm, ulcerated cauliflower like mass which involves the cervix and extends around the uterocervical junction and into the base of the left broad ligament. There is a suspicious firmness between the uterocervical junction and the bladder." The patient complained of dysuria and a rectal tenesmus, both of which were gradually increasing. She showed evidence of loss of weight which was estimated at 20 pounds in the previous 3 months. The operative history of this patient (California Lutheran Hospital No. 84737) is interesting in that she required two separate cautery resections of the bladder with 15 months interval between. With this her carcinoma was rated as a type 3 (Broders) malignancy by the laboratory of the California Lutheran Hospital.<sup>1</sup>

Another patient in this same class is Mrs. N. B. R., age 47. Within the os and invading principally the anterior lip was found an easily bleeding, thickened mass about 2 inches (5 cm) in diameter. The patient came for examination (April 24, 1923) because of a "spotting" that had annoyed her for nearly

6 months. No odor. A cautery biopsy was made from the cervix and submitted to the laboratory of the White Memorial Hospital (Case No. 8232) where it was reported an adenocarcinoma. The operation (April 26, 1923) consisted of first dilating the vagina and coning out the cervix with the cautery knife (Byrne technique) through the uterocervical junction, while an assistant grasped the uterine structures in the pelvis through the abdomen. The ligation of both internal iliac arteries was a part of this procedure, together with the removal of both tubes and ovaries. The water cooled vaginal speculum was again inserted in the vagina and the Percy ball tipped electric heating iron passed to the uterine fundus. It was maintained in this position until the uterus and contiguous parts of the uterocervical ligaments were unbearably hot to the rubber gloved hand of the assistant holding them in the pelvis. The hospital record discloses the development of a vesicovaginal fistula 6 days and a severe hemorrhage from the vagina 8 days, postoperative. The latter complication was controlled by gauze and a Monsel's solution packing followed immediately by a transfusion. Mrs. N. B. R. did perfectly well until April 1925 (two years) when she came in greatly concerned about a painful "lump" which she had discovered at the mouth of the urethra. This proved to be a typical urethral caruncle, but vaginal examination at this visit discloses a rather hard mass estimated to be about half an inch (1 cm) in diameter at the lower margin of the left broad ligament. It is painful when manipulated but not entirely fixed. The patient was instructed to return the following May, i. e. in one month. She failed to report, however, until August. The note on her history for this later month reads: "The mass back of the vault of the vagina on the left side is not only more pronounced but is also much more diffuse." She was sent to the French Hospital where the abdomen was opened the second time August 11, 1925. The "operative record" (No. 3475) which mainly concerns us here in part has the following: "Fixation left broad ligament involving the bladder and ureter. No enlarged lymph nodes at bifurcation of iliacs." "What was done." "Cautery

<sup>1</sup>Consult numerals (Table II) describing complete findings as connected with this patient and (J. C. R.) operation.

panhysterectomy including excision of all fixed structures small uterus, stump of cervix, vault of vagina, left lateral wall of bladder and broad ligament, distal portion of ureter with reimplantation of healthy portion into bladder."

The patient left the hospital in 17 days in excellent condition barring a pronounced foot drop on the right side. This gradually improved so that by March 31, 1926 (nearly eight months later), it had entirely disappeared and the functioning of the foot was practically normal. The onset of the pes equinus was primarily attributed to injury of the sacral plexus during the cautery excision of the mass involving the broad ligament and bladder. It should be noted, however, that 200 milligrams (3 grs.) of spinal novocain was given as part of the anæsthetic. At the Los Angeles General Hospital where the usual maximum spinal dose of this agent is 150 milligrams ( $2\frac{1}{2}$  grs.) in several thousand administrations there is no record of a similar experience. At the present time, 3 years and 2 months following her last operation, and 5 years and 6 months after the first cauterization of the cervix and body of the uterus,

there is no evidence of cancer either locally in the pelvis or generally in the body.

In the treatment of comparable malignant pelvic involvements, if the surgeon will separate the bladder from the uterus with the cautery, isolate the ureters, when necessary, with the same instrument and expose the common iliacs in order easily to tie their internal divisions, and at the same time keep the cautery from puncturing the weak walled and therefore, surgically hazardous iliac veins—and follow this by cautery extirpation of the primary malignant mass, I know that he can do more to render this class of otherwise doomed patients symptom free for an unknown but greater number of years than by any other method so far worked out for the cure or worthwhile palliation of pelvic cancer.

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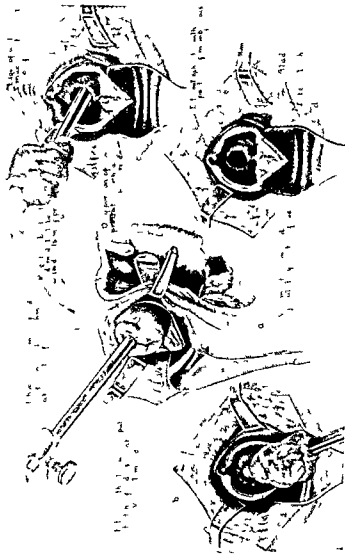


Fig 24 Drawings to illustrate the en masse enucleation of a prostatic hyperplasia by way of the perineum

*Perineal Prostatectomy—Frank Hinman*

# CLINICAL SURGERY

FROM THE UNIVERSITY OF CALIFORNIA HOSPITAL

## PERINEAL PROSTATECTOMY

FRANK HINMAN A B M D F A C S SAN FRANCISCO

THE story of perineal prostatectomy can be written best as an encomium of one American surgeon. It is a one way operation and Young was the first to blaze the trail. Failure discourages all who neglect the fundamental sign posts put up by him. These are facts generally unappreciated. When this subject was suggested upon invitation to contribute an article to this section of Clinical Surgery, the reply was most appropriate.

Perhaps the editor had in mind such a discussion or at least an explanation of the surprising vigor of this operation. The majority of medical men urologists too have been all dressed up for some time in anticipation of a formal necropsy. In any case discussion of the technical details of perineal prostatectomy can be of interest to a limited number of readers for the reason that relatively few surgeons perform prostatectomy by way of the perineum. Those men who have followed successfully the perineal route take so nearly the same steps that the minor differences of technique are hardly worth discussing and are therefore of little interest even to the small group most familiar with the operation. However other surgeons including suprapubics may be sufficiently inquisitive to be interested in a general discussion first of the anatomical principles that limit the performance of this operation practically to one way and to one way only second of the few technical modifications in use as related to these principles, and third, of the best way by which these principles can be taught as indicated by the experience of their twenty five years of life.

### THE ANATOMICAL PRINCIPLES OF PERINEAL PROSTATECTOMY AND CERTAIN MODIFICATIONS OF METHOD

The objectives of the perinealist are Non injury of the rectum and of the external sphincter conservation of the ejaculatory ducts and of the internal sphincter and complete enucleation of the hyperplasia with hæmostasis. Rectal fistula

incontinence of urine or persistence of urinary abnormalities are the penalties of failure. Clean cut dissection of the perineum in the proper line of anatomical separation of the rectum from the genito urinary layer of perineal muscles and prostate is absolutely essential and by far the most important step from a technical standpoint, the one that has caused the most grief to both the surgeon and the patient. Once expert in exposing the prostate without the least damage to rectum and these perineal muscles, the surgeon is master of the situation. Methods of enucleation and of repair while important can vary just a little according to individual preference. But there is no possible variation in the line of dissection to expose the prostate—go too high and you encounter the bulb and bleeding, pass this and continuing too high you expose the triangular ligament, even Cowper's gland, and persisting will invariably injure the external sphincter go too low, and you've got a hole in the rectum. Perineal prostatectomy, therefore, anatomically speaking consists of three stages (1) exposure of the prostate, (2) enucleation and (3) repair with hæmostasis.

*Exposure.* Good surgical exposure of the prostate is no doubt possible without special instruments. Possibly it can be done with ordinary retractors and with the patient in an indifferent spread legged position. Theoretically all that is required is to hug the anterior surface of the rectum to the base of the gland and any clever surgeon with a finger in the rectum as a guide and a pair of dissecting scissors should be able to do this. Large metal guides have even been proposed to be inserted rectally to facilitate the procedure by leaving two hands free for it. But this attitude toward the operation is entirely wrong. Forget the rectum. If you do an anatomical dissection of the perineum, and don't just mess things up to reach the prostate you can forget it, and less than once in a hundred will you have to stick in a finger for help. A good exposure secured by position incision, and retraction is essential to good surgery.

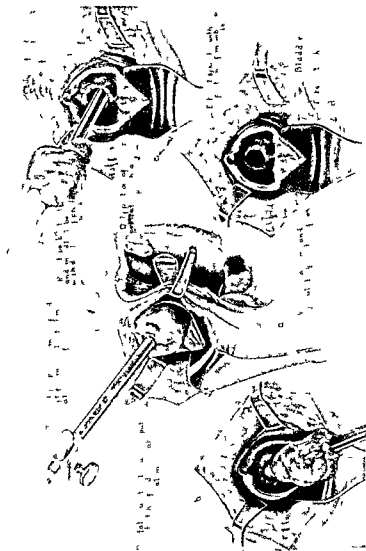


Fig. 24 Drawings to illustrate the *en masse* enucleation of a prostatic hyperplasia by way of the perineum

*Perineal Prostatectomy*—Frank Hinson

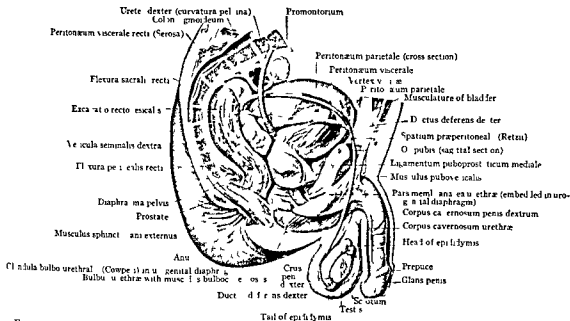


FIG. 4. Diagrammatic representation of the relations of the genital and rectal structures showing how the rectum follows the curve of the sacrum and the genital structures lie snugly against it above. By straightening the bend in the rectum at the flectura parietalis recti plenty of room for prostatic enucleation is secured. (From Braus *Anatomie des Menschen* 2d Ed. 1924 Fig. 211.)

ter levator and coccygeus) and the genito urinary muscles (transversus perinei ischioavernosus, bulbocavernosus and constrictor urethrae) are divisible into an anterior (genito urinary) and posterior (anal) layer. The posterior layer forms the pelvic diaphragm (Fig. 6) but the levator alone concerns the operator. The levator ani is a broad fleshy layer which extends from the anterior and lateral parts of the pelvic wall downward and inward to the middle line and forms together with its fellow of the opposite side a muscular floor to the greater part of the pelvic cavity. It takes origin from the pelvic surface of the body of the pubis by thin tendinous fibers placed between and intimately adherent to the pubic attachments of the obturator and rectovesical fascia from the pelvic fascia along the line of origin of the rectovesical fascia and to a slight extent from the ischial spine. Some fasciculi are also frequently added to the forepart of the muscle from the upper layer of the deep perineal fascia. The hinder fibers pass downward and inward to the lateral margin of the coccyx; the foremost ones run almost directly backward to the central point of the perineum and the intervening ones descend with varying degrees of obliquity to the lower end of the rectum and to a narrow median aponeurosis common to the muscles of the two sides between the tip of the coccyx and the anus.

"The levator ani is divided by a cleft beginning just below the obturator canal into two portions, only the anterior of which is directly connected with the rectum. This portion (the pubococcygeus of Savage) includes the fibers springing from the pubis and the adjoining part of the fascial origin and is to some extent bilaminar; its outer or superficial fibers run backward over the side of the prostate and rectum being closely applied to the highest bundles of the external (anal) sphincter, of which they seem to form a continuation upward and becoming united with the corresponding part of the opposite side behind the bowel are inserted into the tip of the coccyx. The inner or deep fibers are partly inserted into the wall of the rectum making their way between the external and internal (anal) sphincters to join the longitudinal fibers of the bowel, but a few anterior ones meet and decussate with those of the opposite muscle in front of the anus, and the posterior fibers similarly join with those of the other side to be attached to the front of the coccyx."

Those fibers that form a continuation of the highest bundles of the external anal sphincter with those that sometimes are joined to the forepart of the levator muscle from the upper layer of the deep perineal fascia are frequently well developed, thus uniting the rectum more or less securely to

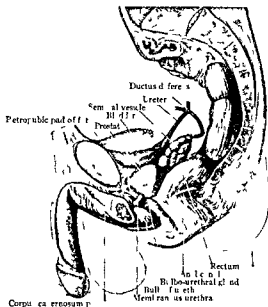


Fig 1 The relation of the normal prostate to the neck of the bladder with the internal sphincter and to the triangular ligament with the membranous urethra and external sphincter and also the intimate relationship of the flexura perinealis recti to the posterior prostatic surface (Reproduced from Liessol's *Human Anatomy* 5th ed 14, 1662)

any place, and a good exposure of the prostate is not secured by simply following the rectum down to it even though this actually is what you do.

The prostate lies between the neck of the bladder with the internal sphincter and the triangular

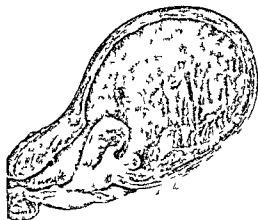


Fig 3 Another view of a median lobe hyperplasia projecting intravesically inside the internal sphincter (From Young's *Urology* vol 1 Fig 19)

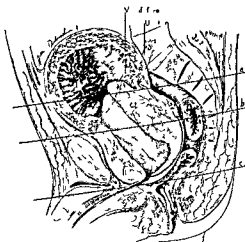


Fig 2 Illustrates the marked elongation of the prostatic urethra with hyperplasia. The verumontanum with the ejaculatory ducts are crowded into the rectal fossa and the mucous surface of the prostatic urethra is markedly increased. The hyperplasia projects intravesically inside the internal sphincter dilating it but there is no disturbance of the external sphincter which lies in the triangular ligament at the position penetrated by the line marked c (From Young's *Urology* vol 1 Fig 239)

ligament with the external sphincter (Fig 1). Enlargements project intravesically inside the internal sphincter but never inside the external sphincter though it may be pushed outward by the extravascular elongation of the urethra (Figs 2 and 3). The rectum passes obliquely forward in the pelvis to the posterior surface of the prostate and then turns backward by the Flexura perinealis recti to follow the curve of the sacrum upward (Fig 4). Freeing the rectum and straightening this perineal flexure exposes the prostate. Familiarity with the position interrelation and function of certain perineal structures makes this possible and insures successful perineal prostatectomy. But it must be emphasized that no part of the human body shows greater variability than some of these perineal muscles so that each operation to a certain extent demands an anatomical dissection of that individual perineum.

The central point of the perineum immediately behind the bulb and about an inch above the anus, is the initial sign post of the operation. It is here sometimes by a fibrous septum at others by direct fusion that the external anal sphincter the two transversus perinei and the bulbo-cavernosus muscles meet (Fig 5). Division of the attachment of the musculus sphincter ani externus at this point is the first step toward freeing the rectum. By this division the anal muscles (sphinc

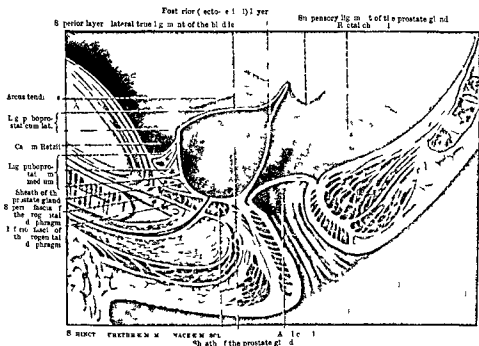


Fig 7 A more or less diagrammatic representation of the fascial coverings of the prostate which shows the posterior (rectovesical) layer generally called the fascia of Denonvillier the splitting of which enables separation of the rectum from the prostate (Cunningham's *Anatomy*, 4th ed 1913 Fig 435)

proper line of cleavage permits a quick, easy and safe separation of rectum and prostate, which straightens the flexura perinealis recti and fully exposes the whole posterior prostatic surface

The trail Young blazed so thoroughly by these two sign posts—the central point of the perineum and Denonvillier's fascia—is traveled in his footsteps by most surgeons although one minor short cut, proposed by John T. Geraghty and the writer at about the same time, is now recognized as safe. These steps with comments from personal experience will be presented but briefly as they are fully outlined and profusely illustrated in many text books and recent surgical magazines

The position of the patient may be a not inconsiderable help in the dissection of a difficult perineum. I still use Halsted's perineal board and place the patient on it with legs so flexed that the perineum is almost parallel with the floor (Fig 8)

For the last 8 years I have been passing Young's seminal vesicle tractor (Fig 9) or Geraghty's tractor (Fig 10) into the deep urethra where it is held closed by an assistant, in place of a urethral sound. Later it can be slipped through into the bladder the blades opened, and then used as a tractor to lift the prostate up in the perineal field (Fig 11)

The incision of the perineum can be too high and it can be too low. It can also be too small. It starts on a level with the anus just inside the ischial tuberosity, arches up across the raphé one and one half inches above and ends at a corresponding point on the opposite side (Figs 12 and 13)

The ischio-rectal fossa on each side is opened up between transversus perinei, levator ani, and rectum by blunt left index finger dissection against the scalpel handle in the right hand (Figs 5 and 14) and Young's posterior bifid tractor is inserted. The conjoined tendon of the anal sphincter is divided (Fig 15) thus exposing the attachment of levator ani fibers to rectum and the genito-urinary layer of muscles (Figs 16 and 20). These rectogenital and recto-urethral fibers are next divided, exposing the apex of the prostate. It is important that this dissection does not injure the transversus perinei which carry important nerves and blood vessels to the structures between the triangular ligaments including the constrictor urethra (Fig 18). The seminal vesicle tractor is pushed into the bladder and opened. By traction and gently prying against the symphysis with its shaft the prostate is lifted by the open blades into the field but against the rectum. The rectum is



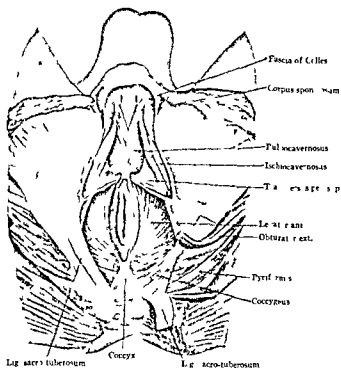


Fig 5 Drawing illustrating the central point of the perineum and the structures attaching at this point namely the bulbocavernosus transversus perinei the musculus sphincter externus and levator ani. Division just below this point is the first step toward separating the anal layer of muscles from the genito urinary layer of muscles. (From Quain's *Anatomy* vol. iv pt. 2 1923 Fig. 72.)

the anterior or genito urinary layer of muscles and are usually designated as the recto-urethral muscle. They are quite variable but when prominent their clean cut division with scalpel is necessary to freeing the rectum at this second step of the dissection. When few and weak blunt finger dissection may easily free the rectum to the apex of the prostate but such blunt dissection must never be forceful as a wrong line of cleavage may lead directly into the rectum. It is well to realize that the sides of the rectum are less vulnerable than the mid surface anteriorly to which the attachments of the genito urinary structures run. As little disturbance of these as possible is desired therefore one often can work to advantage from the sides toward the middle. Gentle pressure on the anterior rectal surface externally with the index finger puts these levator ani fibers that run anteriorly to fuse with the genito urinary layer of muscles on the stretch almost as effectively as an anterior retractor. Anterior retraction when used, should never be forceful as it may injure the con-

strictor urethrae. Division of these recto-urethral fibers brings the dissection to the apex of the prostate, and the beginning of the backward bend of the rectum (Fig. 4). Rectum and prostate are here in close apposition as is so evident on finger palpation per rectum but are separated by a transverse fascial sheath a part of the rectovesical layer (Fig. 7) known to urologists as that of Denonvillier, that is attached to the triangular ligament at the apex of the prostate and spreads out fanwise over prostate and seminal vesicles to unite above with the peritoneum that dips down between the bladder and rectum.

This fascia of Denonvillier is the second important sign post of the operation, as incision of it at the

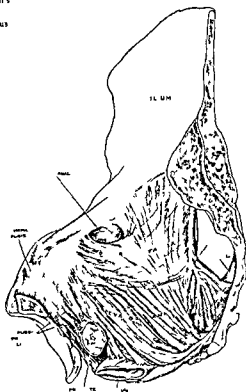


Fig 6 Diagrammatic representation of the pelvic diaphragm formed by the levator ani and coccygus muscles. The few fibers of the levator ani attached to the anterior rectal surface are illustrated coursing just behind the prostate. (From Quain's *Anatomy* vol. iv pt. 2 1923 Fig. 11.)

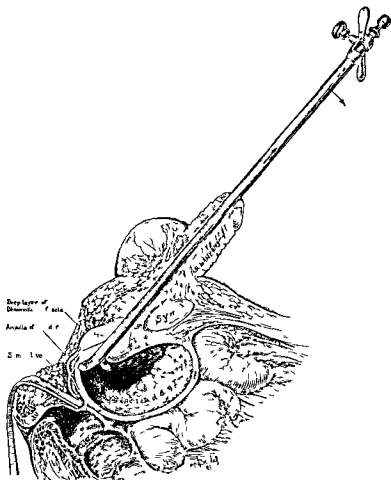


Fig 11. A drawing that illustrates how the vesical tractor by prying against the symphysis lifts the prostate well up into the operative field. (From Young's *Urology* vol. II Fig. 893.)

hyperplastic portions of the gland is secured, through which the entire mass can be shelled out intact under the direct control of eye and hand (Fig 24, frontispiece). The particular precautions at this stage are complete removal with preservation of the ejaculatory ducts and internal sphincter. The ejaculatory duct idea perhaps is too fixed and overdone in most cases. Particularly unimportant is it in those old men on whom vasectomies have been done. But in younger patients not thus protected against epididymitis and in whom restoration of the tract to as near normal as possible is desired the preservation of the crumetanium with its ducts is of considerable importance. This very precaution also minimizes the danger of postoperative epididymitis. Preservation of the internal sphincter is easily

accomplished by stripping it back with finger or dissecting scissors as the hyperplastic mass is freed and delivered. The advantages of the open flap method are better exposure and *en masse* enucleation. The redundant layers of mucosa of prostatic urethra and bladder neck left denuded by the enucleation can be trimmed cleanly with the bladder neck so that no obstructing or irritating tags are left. Visual inspection of the cavity and the neck is improved for cleaning it as well as ligation of bleeding points. It is well to attach one or more clamps to the rim of vesical mucosa that is formed by the division of the mucosal funnel in the final step of detachment of the hyperplastic mass to prevent its being pushed back into the bladder later and then being the source of vesical hæmorrhage that is hard to control or, even



Fig 8 Photograph illustrating the extreme lithotomy position used for perineal prostatectomy. It is seen that the perineum is almost parallel with the floor.



Fig 9 (left) Photograph of Young's seminal vesicle tractor which is passed closed into the urethra in place of a sound and then can be pushed on into the bladder after the apex of the prostate has been reached in the perineal dissection and when opened (Fig 11) the prostate can be lifted well up into the operative field to facilitate the separation of the rectum on the line of Denonvillier's fascia.

Fig 10 Photograph of Geraghty's prostatic tractor. In some instances with the patient in extreme lithotomy position the straight tractor cannot be easily inserted. In these cases Geraghty's tractor which has a urethral curve is substituted.

still between the examining finger in the perineum and prostate which nevertheless is distinctly palpable. By blunt and scalpel dissection at one or the other side of the prostate and away from the rectum, the proper line of cleavage on Denonvillier's fascia is found and followed across the middle to the other side, freeing the rectum from the prostate (Fig 17). Often an anterior tractor to lift the bulb and put the triangular ligament on the stretch is not required. Where the prostate and rectum are particularly adherent, freeing them in the mid part is not necessary, as the incision of the posterior lobe can curve across the apex of the gland from one side to the other and the adherent rectum will drop out of the way attached to this flap of the posterior lobe. The membranous urethra has been neither denuded nor disturbed by the above procedure. The prostate has been exposed similarly to perineal exposure of the seminal vesicles in the operation of seminal vesiculectomy (Fig 11).

The important steps to secure good exposure for perineal prostatectomy, therefore, are (1) position of the patient, (2) incision of the perineum, (3) freeing of the rectum to the apex of the prostate by separation of the genito-urinary and anal layers of perineal muscles, (4) lifting the prostate by an instrument *per urethram* into the field, and (5) exposing its whole posterior surface in the line of cleavage of Denonvillier's fascia.

**Enucleation.** Six of the seven portions or lobes of the prostate may undergo hyperplastic changes,

the posterior lobe alone being immune. The common types are various combinations of lateral, middle, and anterior lobes. Rarely do subcervical or subtrigonal enlargements occur. Most urologists prefer to make a cystoscopic study before prostatectomy, but this study becomes a necessity before removal perineally, for it is of considerable importance to have diagnosed cystoscopically the particular combination requiring removal as well as possible complications such as vesical stone and diverticulum (Fig 19). There are several incisions of choice of the posterior lobe for purposes of enucleation. Young's original contribution was designated conservative because he preserved not only the external sphincter, commonly injured in so called median perineal prostatectomy, but also the ejaculatory ducts to which previously no attention had been paid. This latter was accomplished by making lateral incisions and thus preserving the ducts and verumontanum in the bridge of tissue between (Fig 21). By this method the various lobe enlargements are enucleated separately. It is ideal for bilateral hyperplasia. But when lobes are confluent or ring type complete enucleation is sometimes difficult, smaller nodules being easily overlooked, or when the enlargements are of size they must be removed in pieces, thus endangering the completeness of the procedure otherwise the middle bridge will be torn and mutilated. This is no great disaster, but in most cases cleaner, more complete enucleation is facilitated by the inverted V incision (Fig 22) which also preserves the verumontanum and ducts but by which, in addition, a good open exposure of the

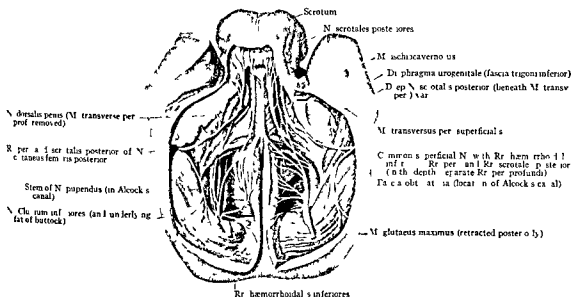


Fig 18 A drawing that illustrates the importance of not injuring fibers and vessels that pass along the transversus perinei to the genito urinary layer of muscles and also the importance of hugging the rectal wall in the dissection of the prostate (From Braus *Anatomie des Menschen* vol II 1914 Fig 43)

stricture at the neck is not uncommon after suprapubic enucleation by which the prostatic urethra is likewise divulsed. The writer has seen four such postoperative suprapubic cases but only in one of his own perineal cases does he know of such constriction. This was a patient with a small fibrous hyperplasia in whom the urethral catheter came out on the second day and urination was re-established so satisfactorily that it was never replaced. As a routine the urethral catheter placed at operation as a guide to the reformation of a prostatic urethra upon the same principles as after external urethrotomy, is retained 6 to 7 days. During this time gentle suction is used so as to keep the perineum dry and quick healing is the rule.

The important steps of enucleation are (1) incision of the posterior lobe, bilaterally, if the enlargement is small and two-lobed otherwise by an inverted curve (2) preservation of verumontanum and ejaculatory ducts in patients not vasectomized, (3) replacement of the urethral tractor by the short prostatic tractor, passed into the bladder through the prostatic urethra opened up by one of the lateral incisions or by the curved incision so as to give more direct traction (Figs 23 and 24 frontispiece) (4) complete clean removal of all the hyperplasia (5) preservation of the internal sphincter, and (6) treatment of the redundant prostatic and vesical mucosa so as to leave no tags or bleeding points.

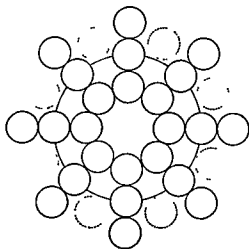


Fig 19 Chart in use for recording findings at the time of cystoscopy and by which the exact type of hyperplasia may be indicated. The three circular rows of eight views are for the near mid and far positions of the cystoscope with respect to each the views of course often changing markedly according to whether the cystoscope is elevated so as to bring the vesical neck near the field or whether it is depressed so as to bring it at some distance away. By this sort of manipulation the position of the shaft in the right or left sulcus of the middle lobe can readily be demonstrated. The dotted circles are for the purpose of recording changes of view for any one position with such manipulation. (See Hinman Chart for recording cystoscopic examinations J Urol 1918 II 433-444)



Fig 12

Fig 12 Photograph of incision of perineum. The fingers of the operator rest just inside the ischal tuberosity from and to which the curved incision goes (Fig. 13)

Fig 13 Photograph of incision of perineum curved across from ischal tuberosity to ischal tuberosity



Fig 13



Fig 14

Fig 14 Photograph of the method of blunt finger dissection into the left ischioanal fossa. The route taken by the finger being illustrated diagrammatically in Figure 5. The finger must enter the space just below (dorsal) the transversus perinei never above (anterior)



Fig 15

Fig 15 Photograph illustrating the first step toward separation of anal and genito urinary muscle layers by the division of the conjoint tendon of the anal sphincter. The blades of the blunt tractor are shown passing into the ischioanal fossa above the rectum on each side of this conjoint tendon.



Fig 16

Fig 16 Photograph of a still deeper dissection than shown in Figure 20. The seminal vesicle tractor can be palpated through these fibers that have been placed on the

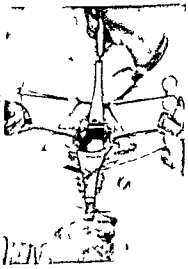


Fig 17

stretch by the two tractors. Dissection still follows the rectum as closely as possible.

Fig 17 Photograph showing the posterior prostatic surface from which the rectum has been separated on the line of cleavage of the fascia of Denonvillier and which is held well up in the perineum by the seminal vesicle tractor that has been inserted into the bladder and opened. The membranous urethra with its external sphincter has not been denuded nor disturbed.

when slight, produces clots that plug the catheters and trouble postoperative care. A possible disadvantage is predisposition to stricture in the

course of restoration of the prostatic urethra inasmuch as the whole of the prostatic urethra is removed with the peniurethral hyperplasia. A con-

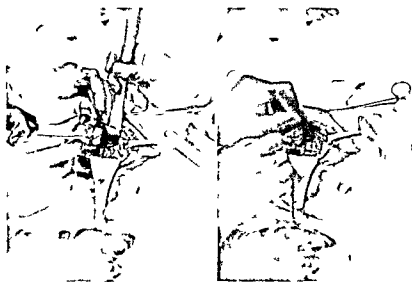


Fig. 22 (left) Photograph of V shaped incision of the posterior lobe of the prostate which also leaves a bridge of tissue carrying the ejaculatory ducts so that they can be preserved and which has the added advantage that a wide open exposure of the hyperplastic portions to be enucleated is secured. Tissue forceps are seen to grasp the apex of this V bridge and the scalpel points to the hyperplasia bulging through the incision.

Fig. 23 Photograph taken with the V bridge held posteriorly so as to expose the seminal vesicle tractor in the prostatic urethra. At this stage this tractor is withdrawn and the short prostatic tractor of Young inserted so as to give more direct and better control of traction for enucleation.

The important steps of repair are (1) control of hæmorrhage by suture or ligature, (2) urethral retention catheter, (3) special perineal catheter for compressing the neck so placed that the redundant mucosa is not everted (4) small prostatic (gauze protective) pack, only when necessary, (5) suture of V flap of posterior lobe incision into place on both sides if no bleeding and neither tube nor pack used, on one side with tube and pack issuing at other when used, (6) infraprostatic pack when indicated, and (7) closure of perineum.

#### THE TEACHING OF PERINEAL PROSTATECTOMY

Theoretically the perineal route has many points of superiority over the suprapubic but it never has been popular because of the difficulties of technique. It used to be said the one is hard on the doctor but easy on the patient whereas the other is easy on the doctor but hard on the patient. Too distressing are the evidences of failure for one to persist in attempts to master the details of technique when another route that is easy and as a rule kills or cures is at hand. No longer is there enough difference in mortality to stimulate more than a few to make the effort. With few exceptions the men trained by Young and those trained

by them are the practitioners of perineal prostatectomy. There can be no question but that suprapubic prostatectomy is superior to median perineal prostatectomy still practiced in many foreign clinics and the literature has been unfair to Young's operation because of comparisons based on this operation. Before 1903 there were only three American and eight foreign references to perineal prostatectomy (*Index Medicus*), from 1903 to 1915 there were 145 articles published by foreigners to 98 by men in the United States whereas during the last 12 years there have been 66 American publications as compared to only 22 foreign and many of these latter were reports on a few cases or large series. This is evidence that the operation is now relatively unpopular abroad. The reason would seem to be the fact that Young's operation is the only one that equals or betters the after results of suprapubic removal, and Young's methods have not been followed. A glance at the American articles of recent years shows numerous modifications (by Cecil, Crowell, Davis, Dillon, Geraghty, Hinman, Lowsley, Lydston, Morrissey, Ochsner, Gibson and Young) endeavoring to simplify the technique, make it safe from rectal or sphincteric injury, and improve certain surgical principles such as hæmostasis. In



Fig. 20. Photograph illustrating the muscle attachments of the rectum to the genito-urinary layer of muscles placed on the stretch by the posterior and anterior tractors. These muscle attachments are divided by the scalpel as closely as possible to the rectal wall so as to avoid injuring the important nerves and blood vessels that pass to the central point of the perineum, in the transversus perinei muscles and their fascia (Fig. 23). The central point of the perineum is held in the anus forceps and it is seen that the transversus perinei in the illustration are a little asymmetrical.

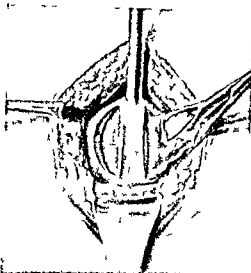


Fig. 21. A drawing that illustrates the method of bilateral enucleation by Young's original method which preserved the bridge of prostatic tissue carrying the ejaculatory ducts. (From Young's *Urology*, vol. 2, Fig. 806.)

**Repair with hamostasis.** The restoration of a good urethra with complete continence is secured only when exposure and enucleation have been done successfully. But the surgical danger of prostatectomy is hæmorrhage and methods to control this need seriously influence the processes of repair. Undoubtedly those cases which do not bleed heal best. Often bleeding points can be seen and ligated but it is rarely safe to rely on this alone, for hæmostasis and the wisdom of taking 20 to 30 minutes more to do this and then have to pack probably is questionable. I am by no means so optimistic as one of my recent associates who recommends this as a possible successful routine of the future.<sup>1</sup> Most cases require either packing or hæmostatic bag or both. In order to disturb repair as little as possible the bag can be small and the packing largely one of outside infra-

prostatic compression against this bag. The most troublesome place of hæmorrhage is that from the neck, which is hard to control by packing and which fills the bladder with clots. All points of bleeding at the neck that can be located should be ligated by suture. This accomplished within a reasonable period the urethral catheter, above referred to, is placed, the inverted V flap of the posterior lobe sutured in place by two or three mattress sutures, and the perineum closed. An infraprostatic pack may be placed for compression of the prostate and obliteration of the cavity of enucleation. Where bleeding cannot be controlled by suture and ligature as is usual with enlargements of size a special mushroom catheter made by Eynard<sup>2</sup> is passed through the perineum on a special stylet into the bladder (Figs. 25 and 26).<sup>3</sup> Traction on it will compress the neck and the prostatic cavity can be lightly packed against it to control bleeding or as in most cases, an infraprostatic pack can be placed outside of the prostate for compression. As material for packing I prefer the gauze protective ribbon (strip of gauze sewn between two layers of protective tissue, Fig. 27) of Charnock<sup>4</sup> because its removal is less painful and it is less apt to stir up hæmorrhage by not being adherent.

<sup>1</sup>For Bard and Company of New York.

<sup>2</sup>This type of bag which can be obliterated by stylet for removal is preferred to the very efficient one of Davis because of ease only.

<sup>3</sup>Charnock, Donald A. A new elastic rubber strip drain. *J. Am. Med. Ass.* 1919, xcii, 982-983.

<sup>4</sup>Gibson, Thomas E. Improvements in perineal prostatectomy permitting primary wound closure and healing without drainage bag. *Gynec. & Obst.* 1925, xliv, 525-539.

of prostatectomy operations performed by 14 of them at the City and County Hospital while in training have been studied. Each one served at least 6 months as chief of this service after 2 or more years apprenticeship as an assistant, and each one performed from 2 to 11 perineal prostatectomies. The results of 70 operations by these 14 men are presented in combination with their answers. It may be said here that all of these men but one prefer the perineal route.

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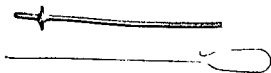


Fig. 25 Photograph of special mushroom catheter for drainage and for traction against the vesical neck to control bleeding. The stylet is shown with a small wire eye at its end which is threaded on to the suture that passes through the lumen of the catheter from its tip so as to guide the end of the stylet securely into the end of the catheter for its removal (Fig. 26)

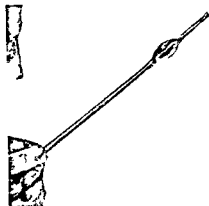


Fig. 26 The stylet has been inserted so as to eliminate almost completely the bulb part of the catheter

all fairness to the originator most of these modifications of Young's classical method are of minor importance and in fact many of them had been previously used or tried out by him independently. If these objects are attained, perineal prostatectomy will continue to rival the suprapubic operation, but probably never will replace it. Its superiority would have to grow considerably for this to happen. The necessary apprenticeship beyond the reach of the majority is a factor in its survival that must be recognized. Rarely has a perinealist been self taught. The life of perineal prostatectomy depends on inbreeding. And yet every perinealist must win his spurs by individual effort. Spoon feeding won't work. In addition it must be recognized that with improvements in preparation and after-care the suprapubic route has also become a much more benign operation than it was 20 years ago. When performed by the open method and with proper attention to hemostasis, it becomes a worthy opponent of its more surgical rival. But judging by published statistics the perineal route has held and still holds the lead for benignancy, the relative figures being about as 3 to 6. In other words, the perineal route will save at least three men in every hundred that would be lost suprapubically in the hands of those most experienced with each method. Taken at large the difference would be as about 5 to 15, but no doubt



Fig. 27 Photograph illustrating the type of protective gauze ribbon used for packing

many of the 10 survivors of perineal surgery done by the casual operator would rather be dead. Perineal prostatectomy is not to be attempted lightly. In spite of the higher mortality, the suprapubic is the operation for the occasional operator.

This difference in surgical risk alone is worth an effort and explains the persistence of a few surgeons in taking the perineal risks of after trouble that could be largely avoided by going suprapubically. But it must be understood in all fairness to the subject under discussion that functional results suprapubically are by no means one hundred per cent perfect. Far from it. The problems of complete enucleation and of repair with hemostasis are just the same, only with this difference—the perinealist has the advantage of better exposure and more direct access to meet them. If certain of non injury to the rectum and constrictor urethrae all urologists no doubt would at once become perinealists.

The big question of interest to all, therefore, is whether the principles of preserving the rectum and the urethral sphincter can be taught and handed down from generation to generation, since this is the only way perineal prostatectomy will survive. That the first generation has carried on successfully is proved by the medical literature of recent years remarkably low mortalities of good sized series being reported by some of Young's pupils. To test the second generation in a small way a questionnaire was mailed to the small group of men now practicing urology who have had their training under me. Their answers have been summarized elsewhere.<sup>1</sup> As further evidence of the practicability of training these men the results

<sup>1</sup>The Teaching of Perineal Prostatectomy. Calif. State Medical Meeting, May 7, 1929.

## PNEUMARTHROSIS OF THE KNEE

A M RECHTMAN, M D PHILADELPHIA

THE injection of oxygen into joints as an additional aid to diagnosis is worthy of wider use than it now is given. It is preferable to replace the generic diagnosis of an internal derangement of the knee joint with a specific diagnosis as loose internal or external semilunar cartilage, rupture of the crucial ligaments, injury to the external or internal lateral ligament, loose body in the knee joint, etc. The use of pneumarthrosis will give more accurate pre-operative diagnoses, and make operative procedures definite rather than exploratory and the less the tissues of a joint are handled and manipulated the more rapid will the postoperative recovery be, while postoperative pain, discomfort, and the possibility of infection are reduced to a minimum.

The history of cartilage derangement is often clear cut, an injury followed by locking of the joint, swelling, localized pain and tenderness. Any of these more or less classical symptoms may be absent. In Case 3 of this series, the patient stated that the condition in both knees had recurred so often that he did not know the number of times and when asked if there was ever an inability to straighten the leg he answered 'no'. The examination, however, showed a ten degree flexion deformity and an appreciable increase of fluid in the joint.

The usual roentgenogram of a normal knee in the anteroposterior view shows a clear space between the tibia and the femur. The normal semilunar cartilages closely approximate the tibia and are not usually distinguishable by the X ray. If a cartilage is loosed and oxygen is injected in the joint, the cartilage is raised and surrounded entirely or partially by the gas. The cartilage may then be demonstrated by X ray according to Kleinberg as an area of density, above and below which is a dark almost black line, the oxygen. In all of Kleinberg's cases the internal cartilage was affected. In the cases reported here, the external cartilage. The findings in these cases differ therefore, in that the cartilage was visible in the interval between the tuberosity of the tibia and condyle of the femur, as a shadow about 3 millimeters in diameter of lesser density than the bone. The oxygen as a dark line was visible in every case between the cartilage and the femur but not beneath the cartilage. The X rays also showed the capsule of the knee joint very satisfactorily and demonstrated the attachment of the internal

cartilage thereto. The oxygen distended and pouched out the internal lateral ligament above and below the inner cartilage but the shadow of this cartilage itself was not seen as there was no pathological change in the inner meniscus. On the outer side the capsule and external lateral ligament are not attached to the cartilage, the dark shadow of gas, therefore, was uninterrupted. The lateral views in all the plates were negative, but showed the distended quadriceps bursa and the posterior capsular ligament. These are seen in the accompanying Figure 1.

A sterile tray is prepared in the operating room. On this are placed articles for scrubbing the hands, gloves, towels, iodine, a rubber tube with a glass connecting tip, several needles of fairly large bore 2 5 inches long, a haemostat, 2 per cent novocain and a hypodermic syringe. An ordinary tank of oxygen is used, the gas passing through the wash bottle to cleanse it. The knee is previously given a two day preparation as for an open operation. The injection is made in the X ray room on the X ray table.

An assistant turns on the gas. The rate of flow is such that when the needle attached to the tank by a rubber tube is held close to the face, a gentle pressure is felt.

## TECHNIQUE OF THE INJECTION

The operation takes but a few minutes. The patient is placed upon the X ray table, the knee painted with tincture of iodine (half strength), draped, and an X ray plate placed beneath it. A 2 per cent solution of novocain is injected below the patella and to the outer side of the patellar tendon. The patella is lifted and the needle is introduced into the joint so that the tip is beneath the center of the knee cap. If an external cartilage injury is suspected it is better to introduce the needle from the inner side so as not to obscure the cartilage. The oxygen is allowed to flow into the joint until it is moderately distended. A haemostat is then placed on the tube, the flow of gas stopped, the tube disconnected from the tank and the anteroposterior view taken. The patient turns on his side and lateral views are made. The haemostat is then removed and the knee deflated. The needle is removed and a collodion dressing applied. A circular sheet wadding and flannel bandages are applied for compression and worn for 3 or 4 days when the remaining gas is entirely absorbed.

FROM THE DEPARTMENT OF GYNECOLOGY, NORTHWESTERN UNIVERSITY

## DELIVERY OF THE UTERUS

ARTHUR H. CURTIS, M.D., F.A.C.S., CHICAGO

**I**NCREASED interest in the study and treatment of lesions of the cervix has impressed upon all of us the frequent inaccessibility of this organ. This may perhaps account for the high incidence of unsatisfactory results following cervix operations. The range of mobility of the uterus has always been accepted to be relatively limited except in patients with undue relaxation of the supports, as a matter of fact, *with proper leverage upon the bases of the broad ligaments a surprising degree of mobility can be obtained.*

The object of this communication is to present a method of delivery of the uterus to the vulvar orifice or beyond—a procedure easily accomplished in nearly all patients except in the presence of far advanced cancer or unusual instances of inflammatory fixation.

The anterior lip of the cervix is grasped, the uterus is pulled downward as far as possible, and a bullet forceps "bites" deeply into the base of the left broad ligament where it joins the uterus (Fig. 1). The cervix is now drawn toward the left and the right broad ligament deeply grasped by another forceps. Repeated "bites" may be re-

quired before a satisfactory grip is obtained in the broad ligaments (Fig. 2). The two bullet forceps, as now applied upon the base of each broad ligament, (assisted, if desired, by the anterior lip forceps) serve as levers which deliver the uterus to the vulva or beyond (Fig. 3).

Increased accessibility of the cervix is a distinct asset in the diagnosis of suspected malignancy and in the study of various other cervical and endocervical lesions, in treatment, it greatly facilitates the introduction of radium needles and simplifies the employment of surgical diathermy and is of great help in various cervical operations.

I have employed "delivery of the uterus" for approximately 15 years. In my earlier experience it appeared too simple to merit publication. With the passage of time, however, the scope of its usefulness has become immensely broadened until we now feel that it is one of our most valuable assets in operative technique. Recognition of the difficulties encountered even by skilled gynecologists in a considerable proportion of operations upon the cervix impels me to advocate more general use of this measure.

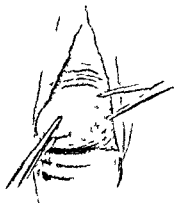


Fig. 1

Fig. 1 The anterior lip of the cervix is grasped, the uterus is pulled down as far as possible, and a bullet forceps "bites" deeply into the base of the broad ligament where it joins the uterus.



Fig. 2

Fig. 2 Semidiagrammatic illustration of application of bullet forceps to the bases of the broad ligaments.

Fig. 3 The two bullet forceps serve as levers which deliver the uterus to the vulva or beyond.

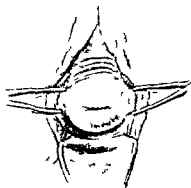


Fig. 3



Fig 3 Case 2 Anteroposterior view of the knee Left the clear space between the femur and tibia may be seen Right the shadow between the outer condyle of the femur and the tuberosity of the tibia is the external semilunar cartilage The dark shadow of oxygen at the outer third of this cartilage indicates the line of fracture The oxygen distends the joint showing the capsule and demonstrating the attachment of the internal cartilage to the capsule and that the outer cartilage is not attached to the external lateral ligament

covered with fibrous tissue was removed which did not show on the X ray plates Complete extension was then possible and the wound was closed in layers Through another incision the inner cartilage was inspected because of the symptoms referred to this side of the joint It was firmly attached and appeared normal The wounds healed by primary union and the recovery was uneventful Two months later the patient resumed her occupation as a teacher and has since remained well

Case 2 Rose G aged 18 years stenographer Two years ago the patient fell and sprained her right knee She limped for a day and was better until 3 months prior to this examination when she had a dull ache at either side of the right knee both at rest and on exertion but there was no limp X rays were negative

Examination on May 24 1927 showed a slight swelling and an increase of fluid in the right knee but not enough to cause the patella to float when the quadriceps bursa was compressed Extension was restricted by 5 degrees There was no grating on motion Pressure over the origin and insertion of the external lateral ligament caused pain but there was no pain on pressure over the external cartilage Lateral motion of the leg on the thigh caused no discomfort The soft tissues on either side of the patellar ligament or about the knee were not thickened The patient had a mild knock knee deformity

A provisional diagnosis was made of injury to the right external lateral ligament of the knee with a possible injury of the external semilunar cartilage The patient was advised to rest the knee, wear a web knee cap and apply hot applications once or twice a day After 4 weeks no improvement occurring oxygen injection for diagnosis was advised and done on June 25 1927 The patient complained of severe pain when the knee was distended with gas but this was relieved as soon as the part was deflated X ray examination showed what appeared to be a dislocated external semilunar cartilage While the condyles were not so far apart than usual there was an increased



Fig 4 Case 4 The external semilunar cartilage slightly displaced outward is seen in the outer intra articular area The oxygen has ruptured the quadriceps bursa and may be seen above the bursa as a dark shadow in the tissues and to either side of the femur

thickening of lesser density than the bone at the posterior part of the external condyle

Further examination of the films showed a transverse fracture of the external cartilage at the junction of its outer third with the inner two thirds This is shown in Figure 3 The oxygen appeared black in the line of fracture of the cartilage Operation was advised

On July 11 1927 a 3 inch vertical incision was made the synovia incised and the cartilage seen to be apparently normal It was divided and the inner half removed The outer half was dissected from its attachment and at the junction of the outer fourth with the inner three fourths a transverse fracture of the cartilage was found When the knee was flexed the posterior fragment of the fractured cartilage slipped back into the joint acting as a loose foreign body which prevented full extension This fragment was excised and the wound was closed in layers

The convalescence was normal until the sixth day when the temperature gradually rose to 102 degrees and the pulse to 120 The white count was 12 250 with 84 per cent polymorphonuclear cells The patient felt well except that she was drowsy Physical examination was negative the wound healed by primary intention and appeared at no time responsible for her symptoms In a week the untoward symptoms subsided and the convalescence was otherwise uneventful She returned to work 6 weeks after the operation and has since remained well

This case demonstrated the value of a pre operative positive diagnosis by pneumarthrosis since the pathology could not be discerned on inspection through the line of incision

Case 3 William F aged 16 years student The patient was well until December 1925 when while playing basket



Fig 1 Lateral views of the knee before and after oxygen injection. Right the dark area indicates the oxygen distending the quadriceps bursa and lifting the patella. The shadow is confined posteriorly by the outpouching of the posterior capsular ligament.

When the joint is distended there is always some discomfort but only one patient complained of considerable pain. When the joint is deflated the discomfort ceases. None of the patients had postoperative pains.

Herewith are reported 4 cases, five external cartilages being treated as both knees were involved in one patient. The X-ray examination after oxygen injection and the operative findings will show why an affected cartilage demonstrable on the operating table may not be shown by the X-ray, even with the aid of pneumarthrosis, and also why X-ray interpretation may arouse suspicions or even be negative. X-ray examination with pneumarthrosis is not pathognomonic; it is only one factor in diagnosis.

#### OPERATIVE TECHNIQUE

The anæsthetic used was nitrous oxide and oxygen. A tourniquet was applied and the knee flexed to 150 degrees to give the best exposure and make the cartilage more accessible. Asepsis was carefully observed and the wound edges were protected with gauze. A straight incision about 3 inches long was made parallel with the outer side of the patellar tendon. This incision made the removal of the cartilage somewhat more difficult but it caused less strain after operation, active motion was started early and the patients were allowed out of bed sooner without fear of weakness in the knee. In each case the wound healed by primary union and the convalescence was uneventful.

#### CASE REPORTS

CASE 1 Anna B. aged 21 years, school teacher. The patient was well until August 29, 1916, when she fell from



Fig 2 Case 1. Left the clear area between the condyles of the femur and the tuberosities of the tibia is seen. Right the oxygen may be seen as a black shadow between the inner condyle and tuberosity, and the prominence of the outer cartilage is shown as a shadow of lesser density. The quadriceps bursa is distended by the oxygen and the needle is seen beneath the patella.

a fence rail about 28 inches above the ground, the knee being flexed beneath its fellow. She had immediate severe pain and was carried home. She was in bed for 2 weeks and treated with local applications. The inner side of the knee was very painful and the slightest motion and weight bearing were impossible. The patient was given a gas oxygen anæsthetic and a physician attempted to reduce a dislocated cartilage. The patient remained in bed for 10 days when she walked with crutches and later a cane until the end of October. At no time since the accident was she able to straighten the knee although the swelling gradually subsided and she suffered no pain since the attempted reduction.

Examination on December 3, 1916, showed a slight atrophy (one half inch) of the right calf and thigh. There was a one quarter inch swelling, more marked on the inner side of the knee, with a slight increase of fluid in the joint so that when the quadriceps bursa was compressed the patella floated. Extension was possible to 110 degrees, flexion was unrestricted. There was pain on pressure over the external cartilage but no grating on motion. The patient had a marked degree of weak feet. X-ray plates were negative.

A tentative diagnosis of derangement of the external semilunar cartilage was made. The symptoms and subjective findings were on the inner side of the knee, and the objective findings were of an injury on the outer side. For this reason pneumarthrosis was suggested.

On June 27, 1917, injection into the right knee caused but slight discomfort to the patient when the joint was inflated. X-ray showed a prominence of the external semilunar cartilage suggestive of displacement, and it is here pictured (Fig 2). The lateral ligament was plainly visible outside of this shadow, the internal lateral ligament was visible on the opposite side.

At operation on July 6, 1917, a 3 inch vertical incision was made. The cartilage was divided and removed and was normal except that it was moderately loose. The knee could not be straightened, and inspection and instrumental palpation disclosed a foreign body closely attached to the posterior spine of the tibia. A small particle of bone

## SUMMARY

A few cases are reported to suggest the wider use of pneumarthrosis as an aid to diagnosis and treatment. The procedure is simple and in these cases shows that a loosened cartilage may be demonstrated and a fractured cartilage at times definitely shown. Pneumarthrosis should not be used indiscriminately, but only in those cases in which a further aid to definite diagnosis is sought.

The greater popularity of pneumarthrosis will tend to make the interpretation of the films more accurate especially as the findings are checked by operation.

It is also believed that after immediate and active treatment following an injury to one of the

cartilages of the knee, if pain and swelling persist and there is an inability completely to extend the knee, an operation is indicated to prevent a chronic synovitis and arthritis.

I wish to express my thanks to Dr. Milton Percival of the Methodist Episcopal Hospital who made the X-ray pictures shown in this series.

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## A SUGGESTION FOR OPENING THE PARIETAL PERITONEUM IN LAPAROTOMY

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THE plan here suggested for opening the peritoneum has been employed in the clinic for several years. It has proved so generally useful and effective in protecting the bowel from injury that it seems worthy of illustration and description.

The procedure, as is well illustrated in the drawing, may be described as follows. The surgeon and assistant grasp the peritoneum in two pairs of forceps, lift upon the forceps so that the lax peritoneum is pulled into a peak and with the blunt handle of the knife press into close contact the two underlying moist surfaces of the peritoneum. In addition to holding the two surfaces of the peritoneum together, the knife handle as it is pushed downward presses away any underlying bowel or omentum. It will be realized that in order to make the two peritoneal surfaces adhere as they do by negative pressure, there must be just sufficient upward pull upon the two pairs of forceps in the hands of the surgeon and assistant to create a negative pressure but not sufficient to cause the diverging walls of the peritoneal folds to separate.

It is clear, of course, that this procedure is dependent upon the peritoneum being so lax that it can be drawn up into a fold and that this technique should not be used if the peritoneum is not lax.

As soon as the two folds of parietal peritoneum have been brought into contact as shown in the

illustration (Fig. 1), an incision may be made in the apex of the fold without danger that a loop of bowel or a section of omentum be included in the fold, since the interposition of either bowel or omentum between the two folds of peritoneum prevents the close adhesion of their two surfaces by negative pressure.

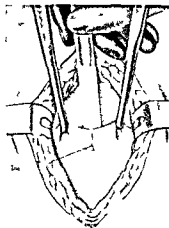


Fig. 1. Showing the method of grasping the lax parietal peritoneum between forceps, the upward traction to create negative pressure and the knife handle pressing the two moist peritoneal surfaces together where they are held by negative pressure.

ball he twisted his right knee and fell with the right leg beneath him. He heard something snap in and out. The knee was not swollen and the leg could be straightened but he walked with a limp for a long time and the knee was sore. In February 1916 the same thing happened to the left knee and also in April while pole vaulting. The condition recurred so frequently in both knees that he had no idea how often. He said there was no swelling and he could straighten the knee after these accidents. The last injury was in the right knee and occurred 1 week ago.

On examination June 30 1927 the boy walked with a moderate right limp. There was a one quarter inch swelling in the right knee and in the region of the quadriceps bursa. The lateral sulci either side of the patella were partially obliterated. The distention was due to fluid and when the quadriceps bursa was compressed the patella floated. There was no pain on pressure over either cartilage or at any place about the knee. Extension was possible to 165 degrees. Examination of the left knee was negative. Thirty cubic centimeters of a clear straw colored fluid was removed from the right knee by aspiration. Internal derangement of both knees was apparent. Because of the absence of localizing symptoms subjective or objective oxygen injection was done July 2 1927.

Previous X ray examination of both knees was negative. There was only slight discomfort when the parts were inflated. After inflation X ray films showed a prominent left external semilunar cartilage but all the others appeared negative.

On July 14 1927 a Kranda incision was made exposing the quadriceps bursa of the left knee which was normal. The patella was dislocated to the outer side thus giving free access to the knee joint. There were many synovial fringes especially in the anterior part of the joint which were removed. The infrapatellar fat pad was hypertrophied and had many fringes. The internal cartilage was moderately loose but otherwise negative and was easily removed. The external compartment was exposed by dividing the infrapatellar fat pad which was removed. Just lateral to the center of the external cartilage on its superior surface was an attached plaque of cartilage crescentic in shape and about three-eighths inch in diameter. Another such plaque but much smaller was found near the posterior horn. The cartilage with the attached plaques was removed and the wound closed in layers.

A 3 inch vertical incision was made over the outer cartilage of the right knee. The synovia bulged into the wound because of the increased tension of the intra articular fluid. When the joint was opened straw colored fluid gushed forth. There was no evidence of any change within this or any of the joints as a result of the oxygen injection. The external cartilage was loose and a plaque of cartilage one inch in length resembling that in the left knee but much larger, was attached to its superior surface. This plaque extended outward from the inner third of the cartilage. The cartilage and plaque were removed and the wound was closed in layers. The convalescence was uneventful except for a slight increase of synovial fluid in the left knee for about 4 months. Three weeks after the operation the patient was horseback riding motorcycling swimming and roller skating and a month later he was playing football.

This case demonstrates the unreliability of the patient's observations. He did not know how often the injury occurred or which side of the knee was uncomfortable. He was not cognizant that after injury the knee was swollen or that it could not be fully extended. Physical examination did

not aid us in localizing the pathology. It is in cases such as these that pneumarthrosis is of diagnostic value as well as an aid in the minimizing of the trauma of operation. The cartilages appeared normal, even with pneumarthrosis as the plaques were not sufficiently elevated to be recognizable.

CASE 4 Minnie S. aged 12 years. The chief complaint was a snapping in the right knee. She was well until 3 years previously when she fell and was carried home. The next day she limped to the Lankaneau Hospital and a posterior splint was applied and worn for 10 days. X ray films were negative. She had no other treatment. Since the injury the knee was easily irritated by exercise. The pain was general but worse on the outer side.

On examination February 14 1925 the patient walked with a slight right limp and the body tilted to the right. Motion was unrestricted but at 165 degrees of flexion or extension a painless snap was heard seen and felt accompanied by a slight outward rotation of the tibia on the femur. It was best palpated at the joint line just anterior to and above the lower insertion of the biceps tendon. There was a one quarter inch atrophy of the knee and a three fourths to one inch atrophy of the leg and thigh. The limbs were of equal length.

A provisional diagnosis of snapping right knee due to a dislocating right external semilunar cartilage was made. On February 21 1925 X ray films being negative oxygen injection was suggested. On April 24 1926 there was no greater discomfort than usual until one week previously. The knee snapped almost continuously when patient walked and also when she moved it in bed. This caused pain on the outer and posterior aspects of the knee. The findings clinically did not differ from the original examination 14 months before.

Pneumarthrosis of the right knee was performed on July 30 1926. The patient was only slightly uncomfortable when the knee was distended. X ray examination showed a prominence of the external semilunar cartilage which was displaced slightly externally as seen in Figure 4.

On examination March 12 1927 the patient had pain in the right knee after exertion for the past several months. A diagnosis of strain secondary to the added trauma incidental to use because of the snapping right knee was made and the knee was strapped.

August 16 1927 she was again seen. When the patient was active and jumped about the part snapped and was painful. The patient stated that the right knee was uncomfortable when active and the left when at rest. Neither knee was swollen and all motions were unrestricted. Examination of the left knee was negative.

Without a definite diagnosis and because of the age of the patient operation had been delayed but in view of recent experiences and the similarity in appearance of this and the other X rays a definite pre-operative diagnosis of a dislocating external semilunar cartilage was ventured. This together with discomfort in left knee due probably to added strain led to an exploratory operation.

On August 20 1927 a vertical incision was made and when the synovia was incised and the knee flexed and extended the cartilage was seen to be very loose and tipped backward into the joint. The cartilage was divided and removed and the wound closed in layers. The postoperative convalescence was uneventful. As was usual in this series active motion was encouraged after the first 24 hours and the patient was allowed out of bed in 6 days. The convalescence was uneventful.

## PARATHYROID EXTRACT-COLLIP IN ECLAMPSIA AND ALLIED CONDITIONS

## REPORT OF CASES

R ERNESTO LÓPEZ M D, NEW YORK

INSPIRED by the works of J C Meakins and William S McCann concerning the effects of the administration of thyroid extract on patients with nephritis and of the diuretic action thus obtained, I thought that as a logical conclusion it would be worth while to try it in cases of pre eclamptic toxæmia with marked œdema high blood pressure and diminished urine with high specific gravity, albumin and hyaline and granular casts

The results obtained, and the facts that I bring out in the historical notes farther down, have encouraged me to extend the experiment to more advanced cases in which the eclamptic convulsions or coma were present

## HISTORY

The works of Vassale and his followers, Stradivari, Zangheri, P Harvier, and others, have clearly established the effects of gestation and lactation upon the functioning of the parathyroid glands

The partial destruction of the parathyroids during pregnancy as well as the fecundation of females who have suffered lesions of the parathyroid—until that time well tolerated—causes the development of grave attacks of tetany, very often fatal The influence of lactation is similar to that of gestation

In cases of eclamptic convulsions in which autopsies had been performed, Pepere found, in 3 cases out of 4, lesions or anomalies of the parathyroid glands Erdheim and Schmorl encountered hemorrhagic lesions in similar cases, Haberer reported atrophy of the glands and Zangheri found only two glands in another case

## ETIOLOGY

It is beyond the scope of this paper to study the etiology and pathogenesis of eclampsia It will therefore suffice to review the studies made in relation to the blood calcium in eclampsia and the drain made upon the parathyroids by the excessive use of this element during pregnancy

Morel prophesied that some day the etiology of toxæmia of pregnancy might be explained by some disordered calcium economy on the part of the patient

Mitchell, in 1910, brought out the theory of calcium deficiency as the cause of eclampsia, and Drennan later on stated that puerperal eclampsia may be caused by a toxæmia the result of a fatty infiltration first and following that, a fatty degeneration of the liver cells, due to the abstraction by the fetus of the calcium

Morel and Rathery reported a lowering of the antitoxic functions of the liver, following the removal of the parathyroid

Ahlfield and Schmorl found in cases of typical eclampsia, pathological conditions which strongly resembled those of acute yellow atrophy of the liver

Kekrer came to the conclusion that there is a calcium deficiency in eclampsia

A number of women suffer from a latent insufficiency of the parathyroid glands which becomes more noticeable during pregnancy This is especially true of the second half of pregnancy during which a large amount of calcium is taken from the mother for use in the fetal bones There are also to be noticed the osseous lesions at times present in the mother such as dental decay, softening of bones, etc "This condition is often aggravated by toxæmia of a disturbed metabolism, or is due to morbid processes occurring in special organs as in the liver, kidneys, etc" (De Lee)

It has become apparent to me that the differences of appreciation relative to the deficiency or lack of deficiency of calcium in the blood of eclamptic patients (see Table I) is due more to the fact that the amount of calcium present in the blood *cannot* always be used as an index to the functioning of the parathyroid glands There is, evidently a deficiency in the functioning of the parathyroid glands which may, or may not, be made apparent by the amount of calcium which is present in the blood

## TECHNIQUE

The determination of calcium was done according to the method of Tisdall and Kramer The serum was separated from the blood and at least 5 cubic centimeters were used The blood calcium values were determined before the use of the parathyroid extracts and another determination was made 15 hours later



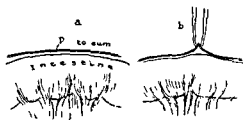


Fig 2

Fig 2 The undisturbed relation of the parietal peritoneum is shown in *a* the relation of the underlying bowel is shown in *b* and the two peritoneal surfaces are pulled upward and made to adhere together by the knife handle in *c*

As shown in Figure 2, when the two surfaces are in close apposition, there cannot be bowel between and when bowel is between the folds of peritoneum they cannot be in adherent apposition.

A further desirable feature of this plan is that as soon as the two adherent layers of peritoneum are cut between the two pairs of forceps, the negative pressure within the abdomen is immediately broken up and, with the entrance of air, the underlying bowel and omentum are pushed

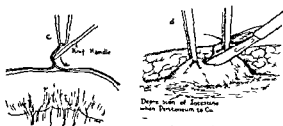


Fig 3

Fig 3 Showing the depression of the abdominal contents away from the cut edges of the parietal peritoneum by the inrush of air as soon as the negative intra abdominal pressure is broken by the incision of the two adherent folds

downward away from the peritoneum so that its edges may be grasped with clamps (Fig 3)

Every operating surgeon knows how easy it is to include an underlying segment of bowel in the grasp of the forceps which pick up parietal peritoneum. While the plan which has been described greatly diminishes the danger of injury to the underlying bowel, in no way does it eliminate the necessity for caution and care in this step of laparotomy.

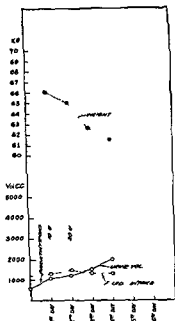


Chart 3 Case 3

pupils were regular and reacted well to light and accommodation. The patient resisted eye examination so that the retina and the disks were not seen. She was  $7\frac{1}{2}$  months pregnant. Blood pressure was 206/136. Temperature 99.4 degrees, pulse 82, respiration 20. Fetal heart was strong 140 per minute. Lungs resonant with normal vesicular breathing, a few crackling rales over both bases.

**Laboratory findings.** Examination of specimens of urine disclosed reaction acid, specific gravity 1.018, very large amount of albumin present, no sugar. Red cells, leucocytes and many hyaline casts were present. The volume of urine in the first 24 hours was very scanty.

Blood examination showed hemoglobin 60 per cent, red blood cells 3,290,000, white blood cells 8,000, differential count normal, smear normal, Wassermann reaction was negative, blood calcium 10.2 milligrams per 100 cubic centimeters of blood serum.

**Course under treatment.** Chart 2 shows graphically the course under treatment. On November 8, 20 units parathyroid extract Colip were given intramuscularly. Ten hours later headache and dizziness had disappeared. The eyesight had improved greatly. Patient was then able to read. Blood pressure remained around 200/135. Twenty units parathyroid were given 12 hours later. Blood pressure came down to 170/114. Patient continued having labor pains but they were very weak and at greater intervals. The urine volume increased to 3,414 cubic centimeters in 24 hours. Blood calcium was 9.9.

On November 10 the blood pressure again went up to 210. Twenty units of parathyroid were repeated. Labor pains ceased. Blood pressure came down and patient started in labor again at midnight, giving birth to a living child at 8 a.m.

The patient was discharged on November 18, the urine still showing a faint trace of albumin, no red cells, leucocytes or casts. Volume was around 1,500 cubic centimeters in 24 hours. The baby was in good health and progressing normally.

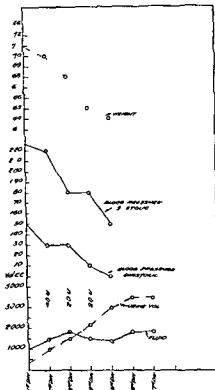


Chart 4 Case 4

**CASE 3** (Treated by courtesy of Dr. J. A. López). Mrs. G.D., a white woman married, aged 27, primigravida, was admitted to hospital on October 28, 1925. Family and personal history are irrelevant. Patient had fair general health. She was pregnant 8 months. Generalized edema involved face, ankles, etc. She suffered severe headache and was dizzy. She weighed 66 kilograms. Blood pressure 125/80.

**Laboratory examinations.** Urine. There was almost a complete coagulation of albumin when the urine was boiled. Specific gravity 1.015. Sugar was not present. There were many hyaline casts and quite numerous granular casts and leucocytes. Blood Wassermann was negative, hemoglobin 50 per cent, red blood corpuscles 4,335,000, white blood count 12,000, blood calcium 9.3 milligrams per 100 cubic centimeters.

**Course under treatment.** On admission a salt-free diet was prescribed, with 60 grams of protein. The liquid intake was kept at 1,200 cubic centimeters. There was no change in weight from October 28 to November 2, the patient keeping constantly around 66 kilograms. The volume of urine voided remained between 450 and 540 cubic centimeters.

On November 2 at 5 p.m., 10 units of parathyroid extract were given intramuscularly and for 24 hours following the urine output doubled, the edema began to disappear and patient lost 1 kilogram of weight. Twenty units of parathyroid were repeated on November 3. The urine volume kept increasing for 8 days to a maximum of 2,400 cubic centimeters and the weight came down to 61 kilograms. Headache and dizziness disappeared. The albumin

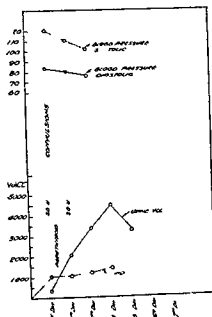


Chart 1 Case 1

In this report the calcium figures refer to milligrams of calcium per hundred cubic centimeters of blood serum. The unit dose of parathyroid extract is "One hundredth of the amount of extract which will produce an average increase of 5 milligrams in the blood serum calcium of normal dogs of approximately 20 kilograms weight, over a period of 15 hours" (Collip)

#### REPORT OF CASES

**CASE 1** J. R., a Porto Rican woman aged 29 years 5 months pregnant was admitted to hospital in state of coma having convulsions every 10 to 15 minutes. The patient had always been in good health, had had typhoid fever in 1912, influenza in 1918. She had been treated occasionally for abscessed teeth. She had been 2 years married but never pregnant before. From beginning of pregnancy, patient complained of headaches, swelling of ankles and legs and nocturia. Two weeks before admission she had had a fall.

**Physical examination.** The patient was a well developed well nourished woman in coma with loud stertorous breathing. Convulsions came every 10 to 15 minutes—generalized rhythmic clonic contractions of head, neck and extremities rolling of the eyes and extreme cyanosis, lips purple, feet torticollis.

Positive findings were many coarse rales and very harsh breathing obscuring lung and heart signs. No edema. Temperature 103 degrees, pulse 145, respiration 68.

**Laboratory examination.** Blood negative Wassermann reaction, hemoglobin 80 per cent, red blood corpuscles 4,500,000, white blood count 9,000, normal differential blood count and normal blood smear, blood calcium on admission 9.4 milligrams per 100 cubic centimeter of blood serum.

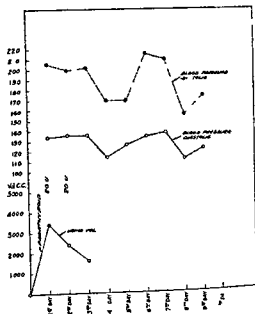


Chart 2 Case 2

The urine when boiled became solid. The sediment contained many hyaline and granular casts. Phenol sulphonephthalein excretion 10 per cent for 2 hours.

**Course under treatment.** The course of events is shown graphically in Chart 1. On admission the urine output was very small, a total of 60 cubic centimeters catheterized specimen in 12 hours. The patient could not swallow and fluids were given by rectum.

Twenty units of parathyroid extract Collip (parathormone Lilly) were given at 2 a.m. (12 hours after admission) and 1/2 grain of morphine every half hour for 4 doses. Four hours later convulsions had stopped, the patient was breathing easily, the temperature was 103 degrees and the pulse was 120.

On February 9, 2 doses of parathyroid extract were given (10 units each). There were no more convulsions. The urine output had increased remarkably and the general condition was fair.

On February 11, the blood calcium was 11.5 milligrams per 100 cubic centimeters blood serum. The blood pressure came down to 102/6. Urine output 3,350 cubic centimeters in 24 hours. (Diuresis continued for 8 days.) Patient began to have pains and after 9 hours of labor was delivered of a macerated fetus.

On March 7, she was discharged in excellent condition. No albumin or casts were present in the urine and the phenolsulphonophthalein excretion was 80 per cent in 2 hours.

**CASE 2** Mrs. E. M., aged 23 years, was admitted to the Pan American Hospital on November 7, 1923, complaining of dizziness, headache, and failing eyesight, approach of blindness. Patient had had a bloody vaginal discharge for several days and was in labor on admission. She gave a history of repeated premature stillbirths following severe edema, albuminuria, and convulsions.

**Examination.** Patient was ill at ease in bed, very pale with generalized edema involving face and ankles. The

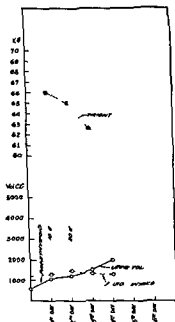


Chart 3 Case 3

pupils were regular and reacted well to light and accommodation. The patient resisted eye examination so that the retina and the disks were not seen. She was  $3\frac{1}{2}$  months pregnant. Blood pressure was 206/136. Temperature 99.4 degrees, pulse 82, respiration 20. Fetal heart was strong 140 per minute. Lungs resonant with normal vesicular breathing, a few crackling rales over both bases.

**Laboratory findings:** Examination of specimens of urine disclosed reaction acid, specific gravity 1.018, very large amount of albumin present, no sugar. Red cells, leucocytes and many hyaline casts were present. The volume of urine in the first 24 hours was very scanty.

Blood examination showed: hemoglobin 60 per cent, red blood cells 3,200,000, white blood cells 8,000, differential count normal, smear normal, Wassermann reaction was negative, blood calcium 10.2 milligrams per 100 cubic centimeters of blood serum.

**Course under treatment:** Chart 2 shows graphically the course under treatment. On November 8, 20 units parathyroid extract Collip were given intermuscularly. Ten hours later headache and dizziness had disappeared. The eyesight had improved greatly. Patient was then able to read. Blood pressure remained around 200/135. Twenty units parathyroid were given 12 hours later. Blood pressure came down to 170/114. Patient continued having labor pains but they were very weak and at greater intervals. The urine volume increased to 3,414 cubic centimeters in 24 hours. Blood calcium was 9.9.

On November 10 the blood pressure again went up to 210. Twenty units of parathyroid were repeated. Labor pains ceased. Blood pressure came down and patient started in labor again at midnight giving birth to a living child at 8 a.m.

The patient was discharged on November 18, the urine still showing a faint trace of albumin, no red cells, leucocytes or casts. Volume was around 1,500 cubic centimeters in 24 hours. The baby was in good health and progressing normally.

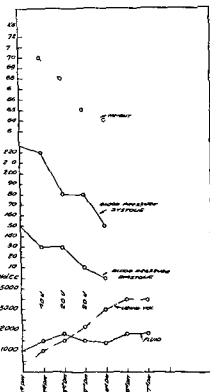


Chart 4 Case 4

**CASE 3** (Treated by courtesy of Dr. J. A. López) Mrs. G.D., a white woman married, aged 27, primigravida, was admitted to hospital on October 28, 1928. Family and personal history are irrelevant. Patient had fair general health. She was pregnant 8 months. Generalized edema involved face, ankles, etc. She suffered severe headache and was dizzy. She weighed 66 kilograms. Blood pressure 125/80.

**Laboratory examinations:** Urine: There was almost a complete coagulation of albumin when the urine was boiled. Specific gravity 1.015. Sugar was not present. There were many hyaline casts and quite numerous granular casts and leucocytes. Blood Wassermann was negative, hemoglobin 50 per cent, red blood corpuscles 4,315,000, white blood count 12,000, blood calcium 9.3 milligrams per 100 cubic centimeters.

**Course under treatment:** On admission a salt-free diet was prescribed with 60 grams of protein. The liquid intake was kept at 1,200 cubic centimeters. There was no change in weight from October 28 to November 2; the patient keeping constantly around 66 kilograms. The volume of urine voided remained between 450 and 550 cubic centimeters.

On November 2 at 5 p.m., 10 units of parathyroid extract were given intermuscularly and for 24 hours following the urine output doubled, the edema began to disappear, and patient lost 1 kilogram of weight. Twenty units of parathyroid were repeated on November 3. The urine volume kept increasing for 8 days to a maximum of 2,000 cubic centimeters and the weight came down to 61 kilograms. Headache and dizziness disappeared. The albumin

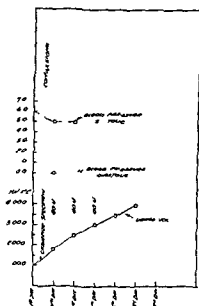


Chart 5 Case 5

man was diminished to a faint trace and there were no granular or hyaline casts present. On November 14 patient entered in labor and was delivered (by Dr J A López) by forceps of a fetus suffering from asphyxia neonatorum and having left club hand and foot. The child died shortly after. Convalescence of patient was uneventful she left the hospital in very good condition on November 25.

**CASE 4.** Mrs SW aged 24 years married primipara pregnant 4½ months. Patient had been under my observation from beginning of pregnancy which had been uneventful until 2 weeks before admission to hospital on March 10, 1923 when she suddenly developed extensive edema with albumin in urine in large amounts and casts. Although patient was kept on a salt free diet with a very low protein intake the patient became more edematous and started to have muscular twitchings, amnesia, extreme nervous excitation, mental unbalance, hemianopsia and vomiting.

**Physical examination.** The patient's weight was 1 kilogram. She was of an ashen pale color apparently very uncomfortable, twitching continually and very cross and irritable. Both eyes showed evidence of albuminuria, retinitis; there were rales over the chest, the cardiac impulse was very diffused and almost inaudible. There was marked edema of the legs and face. Blood pressure 225/150. Urine volume 750 cubic centimeters in 24 hours. Phenolsulphonphthalein excretion was 20 per cent in 2 hours.

**Laboratory examinations.** Wassermann reaction negative. Red blood cells 3,920,000, white blood count 10,400. The urine showed no sugar, large amounts of albumin casts (granular and hyaline). Blood calcium 9.3 milligrams.

**Course under treatment.** Chart 4 is a graphic description of the progress made while she was under treatment. Forty units of parathyroid extract were given intramuscularly. The urine volume increased to 1,000 cubic centimeters

in the first 24 hours; 1,500 cubic centimeters the second day. Blood pressure dropped to 180 the second day and the patient lost 3 kilograms of body weight. Twenty units of parathyroid repeated the third day, urine volume increased gradually to 3,500 cubic centimeters on the sixth day. The blood pressure came down to 150/100 and weight decreased to 64 kilograms, a total loss of 7 kilograms in 6 days. The general condition of the patient had improved remarkably and she was allowed to get out of bed. Phenolsulphonphthalein excretion 80 per cent in 2 hours. Blood calcium 9.7.

The patient was discharged and readmitted a month later when she was delivered of a dead fetus after a few hours of labor. She showed albumin and hyaline casts for 4½ months and she still has a slight trace of albumin in the urine but no casts.

**CASE 5.** Mrs E R., in para pregnant 8 months was treated at home. When first seen patient was having convulsions every few minutes lapsing into coma between convulsions. The history was inadequate; the patient had not been under medical care before.

**Physical examination.** A white woman, lying motionless in bed, her mouth open and covered with a bloody foam, breathing rapidly and with difficulty, cyanosed (of a blue almost black). Suddenly she began to tremble and the respiration almost stopped, her eyes turned, her face twitched and she went into a convulsion lasting several minutes. The blood pressure between convulsions was 160/90.

No laboratory examinations were made.

**Course under treatment.** Eighty units of parathyroid extract were given followed by ½ grain of morphine. The convulsions ceased 4 hours later but the patient stayed in a state of coma until the next day when another dose of 40 units of parathyroid extract was repeated. She slowly came out of coma; however, her mind was blank, showing aberrations and mental unbalance which persisted for 3 weeks until after the patient had been delivered normally of a living fetus. Her postpartum recovery was uneventful.

All of these cases were more or less advanced stages of the same condition "eclampsia parturientum." A few units of parathyroid extract initiated a diuresis usually beginning at the second or third day after injection, which increased daily for 4 or 5 days until the edema disappeared. In 2 cases there was a decrease of blood pressure amounting to 40 millimeters of mercury.

The subjective signs of dizziness, headaches, disturbances of vision and muscular cramps disappeared in the same ratio as the edema.

In the cases of the two patients who had convulsions and other evidences of tetany the convulsions ceased shortly after the first injection.

In no case was labor started by the injections and in one patient who had come in labor, the pains disappeared and did not return while the treatment lasted.

In the patients who came with live fetus, the fetal heart suffered no change and went through in a normal way until labor started.

The calcium in the blood serum did not show an appreciable increase after the use of the parathyroid extract.

TABLE I

	Calcium figures for adults and normal pregnancies				Calcium figures for pathological pregnancies		
	Normal blood	Pregnancy		Post partum	Albuminuria	Pre eclamptic	Eclamptic
Lamers (Serum)	10.81						
Consoh (Blood)	9.0	9.3	9.5				
Ludhill and Dunick (Blood)	6.5 (5.8-8.0)	III mos 7.7 (6.1 to 9.6) IV mos 8.6 (7.3 to 10.1) V mos 7.1 (6.5 to 7.5)	VI mos 7.7 (5.5 to 10.0) VII mos 7.5 (5.7 to 6.0) IX mos 8.1 (6.6 to 9.2)	II day 7.4 (5.6-9.6) X to XII day 7.5 (6.1-9.7)			
Jansen (Blood)	8.75-8.9	III mos 9.8 IV mos 8.0		8.0			
Salmon (Blood)	9.5 to 10.5						
Kehrer (Blood)	7.05-7.53	IX mos 6.59 6.61	IX mos 6.59 6.61	VIII to IX day 6.46-6.64	5.84		
Plass and Bogert (Serum)	9.7 to 10.6	II mos 9.0 III mos 9.1 IV mos 9.4 V mos 9.1	VII mos 8.9 VIII mos 9.0 IX mos 9.0	IV to VII day 9.1 X to XII day 10.1		8.6	8.4
Stanley Duncan and Simon	9.0		IX mos 9.6		10.3	10.2	10.7
Fenbergh and Lash		10.94	10.94		9.5	10.21	10.21
Bockelmann and Bock	10	9.61	9.50				8.95
R. E. López (Serum)						9.5	9.5

The dosage of parathyroid extract used was of a tentative nature. The maximum and minimum dosage will evidently be definitely determined by more extensive research.

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# THE EXPOSURE AND THE ANATOMICAL RELATIONS OF THE FIRST RIB IN AN EXTRAPLEURAL THORACOPLASTY<sup>1</sup>

THEODORE S. MOISE, A.B., M.D., F.A.C.S. BANGOR, MAINE

**A**DEQUATE exposure is a cardinal principle underlying all surgical operations, and the importance of observing this principle increases in proportion to the inaccessibility of the part and its proximity to important structures. The relative difficulty of exposure and the intimate relation of the first rib to important structures lead some surgeons to avoid resecting this rib in performing an extrapleural thoracoplasty; however, experience has shown that the first rib must be partially resected in order to obtain sufficient pulmonary compression. This is due to the fact that the bony chest wall hangs on the first rib, the bucket handle movement of which allows a surprising amount of additional collapse of the chest following its resection.

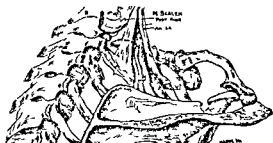


Fig. 1

Fig. 1 The illustration (a postero-lateral view) shows the anatomical relations of the first rib to certain important structures: BP, brachial plexus; A, subclavian artery; and V, subclavian vein. The dome of the pleura is outlined by the heavy broken line. The supreme intercostal artery is seen above the first rib in the space exposed by the displacement of the scalenus posterior muscle. The bracket indicates the portion of the first rib that is resected in an extrapleural thoracoplasty.

Fig. 2 The illustration shows the exposure of the upper ribs in an extrapleural thoracoplasty. Only two ribs remain to be resected. The fourth rib is intact. The first rib has been transected just lateral to the transverse process (see arrow). The important feature to note is that the alignment of the first rib is perfect. This enables the operator to resect the desired portion of the rib before the adequate exposure has been disturbed by the distortion and displacement that follows when this rib is resected last. After the first rib has been resected the fourth is removed with out difficulty.

The insert shows how the alignment of the ribs is disturbed when the first rib is the last one to be resected. The first rib has been transected posteriorly. In practice the

displacement overriding and consequent interference with the originally adequate exposure is greater than is shown in the diagram.

Although satisfactory exposure of the necessary part of the first rib may be obtained by well placed retraction of the upper angle of the incision, any simple method of improving the exposure should be welcome. The following quotation from Alexander<sup>2</sup> accurately describes the situation: 'The first rib is not difficult to identify. Its radius of curvature is very much shorter than that of the second or third ribs. Its first surfaces face superiorly and inferiorly rather than externally and internally as do those of the other ribs and its 'lower' edge presents externally rather than inferiorly. No other rib can be felt above it, if a cervical rib is present that fact will have been determined before operation by the roentgen rays. The firm cords of the brachial plexus can be felt and dimly seen through the

<sup>1</sup>Alexander, John: *The Surgery of Pulmonary Tuberculosis*. Lea and Febiger, 1915.

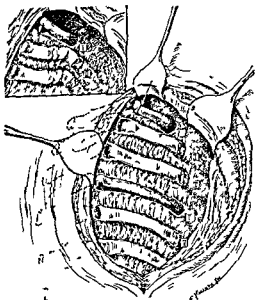


Fig. 2

displacement overriding and consequent interference with the originally adequate exposure is greater than is shown in the diagram.

<sup>1</sup>From the Department of Surgery, Yale University School of Medicine, New Haven, Connecticut, 1924.

areolar tissue which surrounds them as they pass from the side of the cervical vertebrae toward the axilla. Just in front of the brachial plexus can be felt the pulsations of the subclavian artery as it crosses the rib. The plexus and artery are separated from the subclavian vein by the insertion of the scalenus anticus muscle.

"Stripping the periosteum from the first rib, especially from its internal edge, is tedious work as it must be done with care so as to avoid wounding the plexus and artery, the superior intercostal vessels, and the dome of the pleura. In addition to the periosteum the scalenus medius insertion and perhaps a slip of origin of the serratus anterior is separated from the rib. No attempt is made to identify the individual muscles. Removal of a greater length rib than 3 centimeters is technically difficult and exposes the subclavian artery to the danger of being wounded by the cut end of the anterior stump. Brunner has reported a fatal case of erosion of this artery by the stump of the first rib." It is probable that there are unreported instances of similar disasters as well as accidental injuries to important adjacent structures which occurred during operative procedures. The tendency toward widespread adoption of surgical collapse therapy in pulmonary tuberculosis may increase the dangers, and any modification by which the operative risks are decreased will be of value. The purpose of this communication is to describe a method for maintaining excellent exposure of the first rib in the operation of extrapleural thoracoplasty.

The first rib should be resected laterally from the top of the transverse process almost to the groove of the subclavian artery. The anatomical relations of this portion of the rib, as shown in

the accompanying diagram (Fig. 1), are more cogent than any additional comment in directing attention toward the possible dangers incident to its resection.

In the complete operation of extrapleural thoracoplasty the usual procedure is to resect the lower ribs from below upward and then to remove the upper ribs in the following order: fourth, third, second, and first. The disadvantage in this procedure is that after the first rib (the last one to be resected) has been transected posteriorly, there is an immediate collapse, due to the bucket-handle movement of the first rib, with consequent rotation of the ribs downward and backward as a result of which the cut ends of the ribs swing upward. This disturbs the originally adequate exposure of the first rib and makes its second section more difficult (Fig. 2).

This difficulty can be readily avoided if the usual order of resection is altered as follows: If the upper ribs are removed in the order third, second, first, and fourth the alignment of the first rib is not disturbed (Fig. 2) until after its resection is complete as the final collapse follows the resection of the fourth rib. Inasmuch as the exposure and resection of the latter rib is quite simple, the removal of the first rib is thereby rendered safer and easier.

The purpose of this report is to simplify the exposure of the first rib and thus reduce the operative danger for that ever increasing group of surgeons who are performing extrapleural thoracoplasties for pulmonary tuberculosis. If by chance other surgeons have already adopted this simple modification of the technique, their claim for priority will be readily acknowledged by the author.



## FUNDUSECTOMY

## A NEW PRINCIPLE IN THE TREATMENT OF GASTRIC OR DUODENAL ULCER

F. GREGORY CONNELLY, M.D., F.A.C.S., OSHKOSH, WISCONSIN

**S**PEAKING generally, one may safely say that (1) the cause of gastric or duodenal ulcer is not known, (2) the treatment is not entirely satisfactory, but (3) such ulcers are rare in the presence of achlorhydria. The last named fact has served as a basis for recent attempts at radical treatment, i.e., subtotal resection.

A. A. Berg, in a very satisfactory schematic outline (Fig. 1) has visualized the generally accepted understanding of the physiological process of acid production in the stomach. He shows four possible methods of stimulating the acid cells to secretion, viz: (1) afferent impulses, psychic, and through taste and smell, (2) contact of food in stomach, (3) hormones produced in the antrum (not generally accepted), (4) contact of food in jejunum.

The more usual methods of treatment of gastric or duodenal ulcer (duodenal tube, diet, gastro-enterostomy, excision or destruction of the ulcer) and their influence upon acid secretion are diagrammatically depicted in other outline drawings of Berg which show that a reduction of the acid secretion is but slightly affected, the degree of acidity of the gastric contents depending upon neutralization of the acid after its secretion.

Berg found, after sleeve resection that the gastric juice is anacid. He states that this is hard to explain, but attributes it to the destruction of an hypothetical center on the lesser curvature which presumably presides over acid secretion.

The experiments of Ivy, Lim, and McCarthy, of Portus and Portus, of Olch, and of others, failed to confirm such an explanation. The more satisfactory results after sleeve resection might be rationally explained by the removal of acid secreting cells and the retention of the important antro-pyloro-duodenum mechanism which might well be termed the *carburetor* of the gastro-intestinal tract.

The rather unsatisfactory results that followed these methods, other than sleeve resection, prompted Alfred Strauss, Berg, Finsterer, and others to attempt more radical measures such as "longitudinal resection of the lesser curvature" (Fig. 2) and the more generally accepted subtotal gastrectomy (Fig. 3).

(Wm. H. Rodman had previously advocated removal of the "ulcer bearing area.")

Berg found a marked and consistent reduction in acid production after so-called subtotal gastrectomy (75 per cent with no free hydrochloric acid and 10 per cent with low free hydrochloric acid) which was attributed to removal of the second (gastric food contact) and third (antrum hormone) of the four factors regulating the production of hydrochloric acid. The existence of an antrum hormone has not been accepted, and Lim, Ivy, and McCarthy have recently emphasized the importance of the fourth factor (jejunal food contact).

After partial gastrectomy, Klein found immediate anacidity in 78 per cent of gastric ulcers, 18 per cent of duodenal ulcers, after 6 months, 100 per cent and 66 per cent respectively, and considered removal of the second, or gastric factor, as the cause.

Lewisohn and Feldman found 77 per cent had postoperative anacidity after gastrectomy and that only 3 per cent treated for peptic ulcer by gastro-enterostomy had postoperative anacidity.

A logical explanation of this reduced acidity after partial gastrectomy is that of duodenal neutralization and, what has not been stressed is the actual removal of a variable portion of the acid producing cells of the stomach wall.

But Berg's statement, "The only method of treatment, however, that brings about a permanent and lasting anacidity of gastric contents is subtotal gastrectomy," brings one into controversy, in view of the fact that in from 5 to 10 per cent of gastric and duodenal ulcers the gastric secretion is said to be achlorhydric.

For example Balfour reports 28 cases of "recurring ulcer following partial gastrectomy." In 55 per cent the hydrochloric acid content was subnormal and in 26 per cent it was absent. He quotes Burgfeld as having collected 53 similar cases. These were probably not all subtotal resection.

Hurst claims that there are in the literature 100 cases of secondary ulcer after gastrectomy which he attributes to a mythical state called a "hypersthenic gastric diathesis."

Lewisohn and Feldman did not find a case of recurring ulcer with anacidity.

The recurrence of ulcer after partial gastrectomy with hydrochloric acid in the gastric contents may be explained by an incomplete or in

sufficient removal of the acid secreting stomach wall. But such recurrence *without* hydrochloric acid would seem to minimize the importance of hydrochloric acid as a factor in the development of ulcer and calls for a consideration of post-operative achlorhydria, methods of its determination, and its possible causes.

In order to prove the absence of hydrochloric acid, fractional test meals must be repeated and neutral red or histamine should be used as stimulants.

Achlorhydria may be due to lack of secretion of hydrochloric acid or to its neutralization after secretion, so that, with a gastric content that contains no free hydrochloric acid the wall of the stomach may, or may not, secrete hydrochloric acid. The bearing of this fact upon the development or non development of recurrent ulcer opens up interesting possibilities.

With a mucosa that does not secrete hydrochloric acid, ulcer is rare, but recurrent ulcer in 28 cases following partial gastrectomy (Balfour) was associated with hypochlorhydria in 55 per cent and by achlorhydria in 26 per cent.

If hydrochloric acid is present it is reasonable to suppose that too many acid cells were allowed to remain, if hydrochloric acid is absent, granting the accuracy of the observation, all acid secreting cells may have been removed, or cells may remain that continue to secrete hydrochloric acid which is promptly neutralized. The latter may be detected by an estimation of the combined chlorides or by a much simpler method, the injection of histamine or neutral red.

If the combined chlorides are high, it would suggest that acid had been secreted (possibly exerted an etiological influence) and subsequently been neutralized, or the chlorides, themselves might have exerted this possible etiological influence upon the gastric or intestinal mucosa.

On the other hand if, in cases of achlorhydria after partial gastrectomy without recurrent ulcer, it was found that the combined chlorides were low, it would indicate that sufficient acid cells had been removed, and emphasize the importance of hydrochloric acid as an etiological factor in ulcer of the duodenum or stomach and the necessity in partial gastrectomy of removing the acid secreting portion of the stomach.

Winkelstein and Marcus claim that neutral red will allow a differentiation between a true achylia and cases in which a small amount of acid is secreted and then neutralized by duodenal regurgitation.

The object of attempts at radical treatment is that of *preventing* the formation of free hydro-

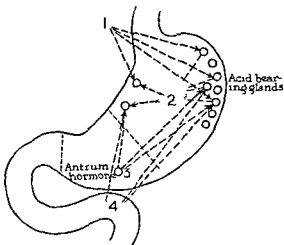


Fig. 1 The usual conception of the mechanism of acid production in the stomach: 1 Afferent impulses psychic and through taste and smell; 2 contact of food in stomach; 3 hormones produced in the antrum; 4 contact of food in jejunum (Modified from Berg).

chloric acid, in contradistinction to the previously mentioned methods that might be called conservative, which aim at *neutralizing* the acid after it is formed, or hurrying it through the stomach by shortening the emptying time.

But the production of a complete, or comparative, anacidity of the stomach contents is a main object in both methods, and subtotal resection seems to accomplish this object in a more satisfactory manner. But it has not met with universal favor and acceptance, because of a high mortality rate (Haberer 8.4 per cent), technical difficulties and persisting acid in a small percentage of cases.

Therefore it would seem that the present indication in the treatment of gastric and duodenal ulcer is to secure an acid free gastric contents by some procedure less dangerous, with simpler technique and more uniform anacidity.

In reviewing the possibilities one might consider the disease, or symptom complex "achylia gastrica" which in certain respects fulfills the requirements.

What then are the causes of achylia gastrica?

The exact cause is unknown but the list of possible etiological factors is long and varied. In 60 cases of true achylia Winkelstein and Marcus found 10 cases of carcinoma of the stomach, 6 cases of pernicious anemia, 3 cases of gall bladder disease, 2 cases of syphilis of the stomach, and 17 cases of subtotal gastrectomy.

A therapeutic attempt to establish in the individual with hyperchlorhydria a moderate degree of pernicious anemia, hypothyroidism, pulmonary

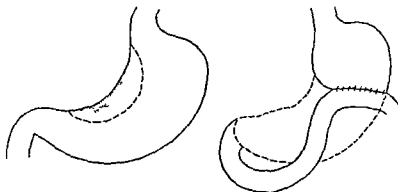


Fig. 2 (left) Longitudinal resection of the lesser curvature (Modified from Alfred A. Strauss)

Fig. 3 Effect of subtotal gastrectomy on acid production (1) not affected (2) doubtful (3) entirely removed (4) not affected. Total result marked 75 per cent of patients. No free hydrochloric acid after operation. Ten per cent of patients free hydrochloric acid below 10. Antrum most important factor in mechanism of acid production (Berg)

tuberculosis, or cirrhosis of the liver, sufficient to cause a symptomatic achlorhydria, but not to a degree that will establish the disease, seems fantastic but the similar use of malaria or rat bite fever in general paresis or erysipelas in sarcoma shows that such a suggestion is not entirely visionary.

The use of X ray treatments for the purpose has been suggested by J. Case and Boldyreff and carried out by Gatch, but has not been accepted. Eugene Klein<sup>1</sup> recommends division of the left vagus.

Other than this there seems to be no satisfactory

method of producing achylia and therefore beg to present what seems to be a new principle in the treatment of gastric or duodenal ulcer, i.e. fundus resection, the removal or destruction of the acid secreting cells with the retention of the important antro-pyloro-duodenal mechanism which controls the transit, the mixing, and the emptying of the gastric contents and regulates the delicate adjustment between stomach and intestinal contents in contradistinction to pylorotomy or subtotal resection which does the reverse that is, allows many acid secreting cells to remain and removes the normal barrier between stomach and intestinal juices, thus allowing acid alkali imbalance.

A difference in function between the two portions of the stomach, one for secretion the other for transit, mixing and regulating outflow and inflow may be demonstrated in different ways for example. In the embryological development of the primitive straight alimentary canal one finds various offshoots, diverticula, evaginations or dilatations which by specialization become various organs, the salivary glands, the liver, the pancreas, the lungs, the thyroid and the thymus (the latter lose their primitive connection with the alimentary canal)—(Fig. 4—Huntgarten).

The fundus of the stomach might readily be looked upon as such a specialized dilatation, an appendage or a remnant of a special structure for the secretion of acid with a broad wide open communication rather than the usual narrow gland duct. The site of the lesser curvature undergoes much less apparent change.

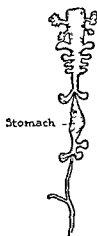


Fig. 4 Schema of alimentary canal and accessory organs

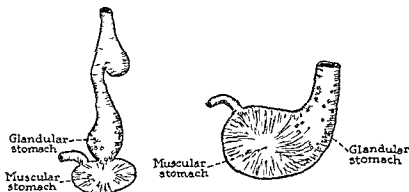


Fig 5 Schema of stomach of granivorous bird Stomach of owl (Huntington)

In comparative anatomy one finds, in certain lower animals, just such a separate portion of the stomach, more or less sequestered, where the acid glands are accumulated in the so called *pre-ventriculus* or glandular stomach (Fig 5—Huntington). In the kangaroo the lesser curvature is converted into a tube (Horsley). In the human, Bauer (according to Ashoff) has directed attention to this phylogenetic vestige of the duct and gland arrangement the indefinite boundary between the two being indicated by the course of the oblique muscle fibers which is explained as a dilated sphincter of a one time active check between the acid secreting and the antro-pyloro-duodeno mechanism.

The fundus and the gastric pathway (*Vagen Strasse*) are not only in different regions of the stomach but the gross appearance of their mucosa is strikingly dissimilar and very suggestive of different functions as is shown by Figures 6 and 7 (Ashoff).

The *lesser curvature* is short, its blood supply is from recurrent branches of gastric and pyloric arteries the mucosa is taut and arranged in longitudinal folds like a drainage gutter suggestive of being used to transfer fluids (Fig 6). The *fundus* is longer its blood supply is from the right and left gastro epigastric arteries and gastric artery the mucosa is loose mobile, and arranged in irregular folds like a gland and suggestive of being used for secretion (Fig 7).

Crohn in a schematic outline (Fig 8) shows these acid forming cells in the gastric wall to be confined practically to the proximal half of the viscus part of which is allowed to remain after the usual operation of subtotal gastrectomy.

1. Miyagawa found the pyloric (non acid secreting) glands to extend two-fifths of the distance of the lesser curvature from the pylorus to the cardia (Fig 9). These painstaking observations

were made in the human upon two adults and one infant.

The masterly work of Lim, Ivy, and McCarthy and of others has conclusively demonstrated that the acid secreting cells are in the fundus, and not the pyloric region of the stomach.

It would seem that, in our treatment, we may have been putting the "cart before the horse" in attempting by what might be called remote control to eliminate or influence the stimuli to acid secretion some of which admittedly cannot be controlled or eliminated by treatment or operation.

Why not stop the secretion of these acid forming cells in the fundus—not by doing something somewhere else, for its reflex action—but by doing something directly to the cells (act as we would if called upon to stop salivary secretion, e.g., remove the gland) by removing the removable portion of the stomach in which the acid secreting cells are situated (the fundus) and, if necessary, destroying the cells in the portion of the wall that must remain for transportation of food.

In the multitude of operative procedures that have been recommended for gastric and duodenal ulcers I am not familiar with the utilization of this principle which may be explained by the fact that the original operations were primarily aimed at the relief of the mechanical difficulties, i.e. obstruction but as these same methods were extended to earlier cases (non obstructive) in which secretory and not motor phenomena were at fault the previously successful methods were then often found unsatisfactory.

By removal of the acid bearing area (the fundus) which is redundant and therefore easily removable is secretorily important but motorly unimportant instead of the ulcer bearing area (the pylorus and antrum) which are not redundant and therefore difficult to remove is secretorily unimportant but motorly important and regulate

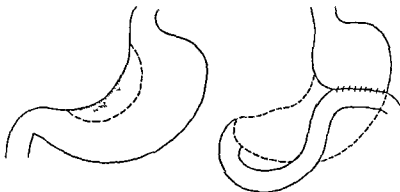


Fig. 2 (left) Longitudinal resection of the lesser curvature (Modified from Alfred A. Strauss)

Fig. 3 Effect of subtotal gastrectomy on acid production. (1) not affected (2) doubtful (3) entirely removed (4) not affected. Total result marked 7 per cent of patients. No free hydrochloric acid after operation. Ten per cent of patients free hydrochloric acid below 10. Antrum most important factor in mechanism of acid production (Berg)

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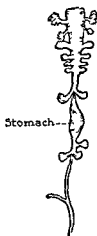
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Stomach—

Fig. 4. Schema of alimentary canal and accessory organs

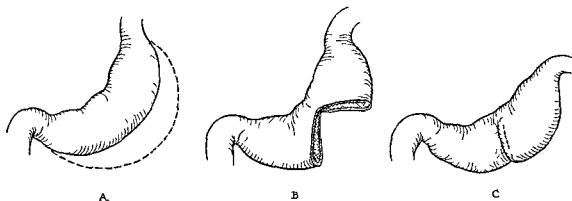


Fig 10 After fundusectomy

should present no serious difficulties to one familiar with gastric surgery. It might be performed as a closed operation, a longitudinal resection of the greater curvature (similar to the resection of lesser curvature as recommended by Alfred Strauss in 1924—Fig 10A) or as a V shaped or wedge shaped excision of the greater curvature (Fig 10B and C).

Fundusectomy may be carried out as a closed operation with clamps, or as an open operation exposing the pyloric and gastric mucosa to inspection or palpation, and if indicated, allowing cauter destruction of remaining acid mucosa.

The danger of peritonitis following such an open exploration will be minimized by the high acidity (a comparative sterility) of the contents.

#### CONCLUSIONS

1 Results of treatment of gastric or duodenal ulcer are not entirely satisfactory.

2 A more radical method—subtotal gastrectomy—has been recommended.

3 Both conservative and radical methods aim at a reduction of gastric acidity—the former by neutralization the latter by prevention of acid secretion.

4 Subtotal gastrectomy removes the "ulcer bearing area" the antro pyloro duodenal mechanism and allows part of the acid bearing area, the fundus to remain.

5 It is suggested for cases without stenosis or other sequelæ, that the acid secreting fundus be removed and the antro-pyloro-duodeno mechanism be allowed to remain.

6 Such an operation should be less dangerous, easier to perform and the result would be more anatomic with diminished acid secretion.

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Fig. 6 (left) System of folds in the stomach opened at the greater curvature



Fig. 7 System of folds in the stomach opened at the lesser curvature

the delicate pyloric mechanism) it would seem logical to expect a reduction in acidity, with a more physiological gastro-intestinal sphincter and a resultant beneficial influence on those prone to gastric or duodenal ulceration.

In the usual operation the "ulcer bearing area" and the *Magen Strasse* are removed, because they are "vulnerable."

Vulnerable to what? To hydrochloric acid, and an attempt is made to overcome this vulnerability by removing the vulnerable structure and substituting tissue supposedly less vulnerable. We herewith recommend the other horn of the dilemma, viz., to remove the acid secreting cells and allow the motorly important *Magen Strasse* and ulcer bearing area to remain intact. Such an operation is technically easier, the result is more anatomic, and it diminishes acid secretion.

#### INDICATIONS

In cases in which the disease has progressed to the development of sequelæ such as stenosis,

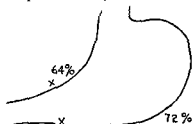


Fig. 8 Showing distribution of acid forming cells (Crohn.)

perforation, hæmorrhage, or malignancy other or additional measures will be required.

The operation of fundusectomy is indicated for the correction of secretory and not motor abnormality, such as persistent hypersecretion without organic stenosis as is often seen in duodenal ulcer or after surgical treatment, in jejunal or gastro jejunal ulcer, and less frequently in gastric ulcer.

#### TECHNIQUE

The operative steps need not be discussed here, the question at this time being whether the theoretical claims do, or do not, justify such an operative procedure, the technique of which

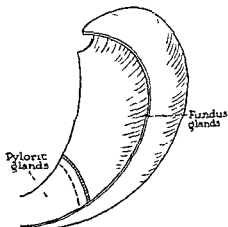


Fig. 9 The human stomach. (Y Miya,awa.)

plete lack of fecal and gas control was admitted or complained of by 167 patients, partial lack of control was complained of by 102

#### DURATION OF SYMPTOMS

	Number of patients	Percentage
Less than one year	52	17.5
One to two years	34	11.7
Two to three years	17	9.1
Three to five years	47	16
Five to ten years	65	22.4
Ten to fifteen years	7	9.3
Fifteen to twenty years	10	3.4
Twenty to thirty years	14	4.9
Thirty to forty years	5	1.6
Forty two years	2	0.68
Not recorded	8	2.7

#### PREVIOUS OPERATION FOR COMPLETE PERINEAL LACERATION

At the time of first admission to this clinic 78 patients had had previous complete tear operations

Sixty two had had one previous repair. Ten of these had been cured or relieved but had suffered a recurrence as a result of later labors (6 had had one later labor, 3 had had two and 1 had had four later labors). The repair had been unsuccessful in the remaining 52 cases, sepsis being the cause of failure so far as can be determined. Of this group 42 had been repaired immediately after delivery.

Twelve patients had had two previous perineal repairs. One of these relieved by one operation, had a recurrence with a later labor. None of the other 23 operations had resulted in cure, 16 having been performed immediately following delivery.

Three patients had had three previous repairs. One of these cured by the first operation had had a recurrence after three more labors and had received only slight benefit from her second and third operations. All three operations had been unsuccessful in the other two cases.

One patient had had four unsuccessful perineal repairs.

It should be emphasized that only 18 of this group are recorded as having had their repairs performed in a hospital.

#### EXAMINATION

One hundred and three patients were found to have tears through the sphincter, to or into the anus. In many instances a thin band or scar tissue bridged over the hiatus. Tears running into the rectovaginal septum for from 0.5 to 3, rarely to 4 or 5 centimeters were found in 187 patients. One patient was found to have in addition a complete inversion of the uterus. She had had a forceps delivery 11 weeks before and had entered

TABLE I TYPES OF DELIVERY

	Number of cases	Percentage
One instrumental delivery	157	67.3
Two instrumental deliveries	43	18.0
Three instrumental deliveries	9	3.8
Four instrumental deliveries	5	2.1
Five instrumental deliveries	3	1.2
Six instrumental deliveries	4	1.7
One breech delivery	9	3.8
Two breech deliveries	1	0.4
Craniotomy (14 and 15 lb. babies)	2	0.8
Foot presentation	1	0.4
Total	234	

the hospital because of flowing. Two months after operative restoration of the uterus complete perineorrhaphy was performed. Two years four months later she was delivered normally of a full term baby.

Twenty one patients were discharged without operation. 1 was pregnant, 10 refused operation, and 10 were considered unsafe operative risks on account of old age, diabetes, pulmonary tuberculosis, or hypertension.

#### TREATMENT

*Preparation for operation* consisted of catharsis (one ounce of castor oil 24 hours before operation), a soapuds enema and a boric acid douche 16 hours before operation, and another enema 6 to 8 hours before operation. A light diet with plenty of fluid and carbohydrate was given.

*Operation*<sup>1</sup> In 74 cases in which the perineal separation was in the lateral sulci the first part of an Emmet operation was performed, i.e. the lateral sulci were denuded and sutures placed thus uniting the anterior portion of the levator ani muscles to the sides of the rectum. In 196 cases in which the tear was in the median line and not along the sides of the rectum either the first part of a Clark operation or a simple median triangular denudation was performed with catgut approximation from side to side, care being taken not to make the introitus too tight. When the tears extended far up the rectovaginal septum, the denudation was begun above the upper angle of the wound and was carried down on either side to the Bartholin ducts, care being taken to remove only a small amount of tissue in the region of the introitus. The tear in the rectum was then closed with interrupted fine catgut sutures down to the anus after which the vaginal mucous membrane was approximated with interrupted catgut sutures to the introitus.

When the internal part of the operation was finished the external part was treated as follows: a

<sup>1</sup>Graves Gynecology 41b ed.





## COMPLETE LACERATION OF THE PERINEUM

A REPORT OF TWO HUNDRED AND NINETY ONE CASES SEEN BETWEEN 1876 AND 1928 AT  
THE FREE HOSPITAL FOR WOMEN, BROOKLINE, MASSACHUSETTS

GEORGE VAN S SMITH M.D. AND JAMES R. LINTON M.D. BOSTON

THE present article is a single item in a general critical survey that has recently been carried out at the Free Hospital for Women of all the principal operative procedures there employed since the date of the hospital's inception, in 1875. The purpose of this statistical research is to establish a standard of comparison that may prove of use in the future work of this and other clinics. Since studies and reports of cases of complete perineal laceration are meager, this paper was undertaken in order to review the results of a fairly large experience in the treatment of this lesion.

The series of cases of complete perineal laceration herein reviewed was studied from the following aspects: etiology, age, the severity and duration of symptoms, operative procedures, complications, immediate and late results, and results when pregnancy occurred following operation. It is composed of all the cases of third degree tear seen at this clinic over a period of 51 years and of 4 cases in which incompetence of the anal sphincter was not associated with childbirth. One of these four, a single girl of 20 who suffered from urinary and fecal incontinence, showed no anatomical defect. Although the cause of incontinence was probably neurogenic, operation resulted in a cure. The second, a single girl of 22 years, owed her complete tear to the trauma of falling astride a fence 9 years previously. In the two remaining patients, the loss of sphincter control was the result of postoperative complications. One had been operated upon for hemorrhoids and fistula in ano, the other for an abscess of Bartholin's gland.

In 287 cases complete laceration had occurred during childbirth. The histories of 19 of these contain no statement concerning delivery. Abnormal delivery was recorded in 234 cases or 87.3 per cent of the remainder. The types of delivery are recorded in Table I.

The occurrence of toxæmia was recorded twice of convulsions or eclampsia six times. Only nine patients gave a history of delivery in a hospital.

Of the 34 cases recorded as having had normal labor, eleven had had one or two children, nine

had had three or four, and fourteen had had five or more.

### LABOR AT WHICH TEAR OCCURRED

Labor	Number of patients	Per centage
First	183	64.6
Second	41	14.3
Third	24	8.1
Fourth	15	5.2
Fifth	5	1.7
Sixth	6	2.0
Seventh	2	0.69
Eighth	2	0.69
Ninth	1	0.34
Thirteenth	1	0.34
Fourteenth	1	0.34
Unknown	4	1.3

### AGES WHEN COMPLETE LACERATION OCCURRED

Age	Number of patients	Per centage
At age of 13	1	0.3
Between 15 and 20	31	10.6
Between 20 and 25	83	30.1
Between 25 and 30	91	31.0
Between 30 and 35	50	17.3
Between 35 and 40	22	7.5
Between 40 and 45	5	1.7
Between 45 and 50	2	0.69
Congenital	1	0.3

### SYMPTOMS

In a typical case the chief complaint is incontinence both of gas and feces. Frequently, however, patients complain of incontinence of gas only, fecal incontinence occurring only when the movements are loose. Since constipation is so common among women, complete tears can often be tolerated for years without undue inconvenience. In 22 cases of this series incontinence of gas and feces was not complained of at all and it was only on examination that the complete tear was found. Undoubtedly, failure to complain of fecal incontinence was occasionally due to embarrassment. Symptoms such as headache, weakness, backache, pelvic discomfort and bearing down were sometimes more prominent. Two patients complained of fecal incontinence only at the time of menstruation. A few patients had no symptoms from the complete laceration until months or even years after the injury. This late occurrence of symptoms was due probably, to the changes that accompany atrophy of the pelvic tissues. Com-

\*This does not include many cases that came to the Out-Patient Department but failed to report for treatment in the main hospital.

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#### PREVIOUS OPERATION FOR COMPLETE PERINEAL LACERATION

At the time of first admission to this clinic 78 patients had had previous complete tear operations

Sixty two had had one previous repair. Ten of these had been cured or relieved, but had suffered a recurrence as a result of later labors (6 had had one later labor, 3 had had two and 1 had had four later labors). The repair had been unsuccessful in the remaining 52 cases, sepsis being the cause of failure so far as can be determined. Of this group 42 had been repaired immediately after delivery.

Twelve patients had had two previous perineal repairs. One of these relieved by one operation had a recurrence with a later labor. None of the other 23 operations had resulted in cure, 16 having been performed immediately following delivery.

Three patients had had three previous repairs. One of these cured by the first operation had had a recurrence after three more labors and had received only slight benefit from her second and third operations. All three operations had been unsuccessful in the other two cases.

One patient had had four unsuccessful perineal repairs.

It should be emphasized that only 18 of this group are recorded as having had their repairs performed in a hospital.

#### EXAMINATION

One hundred and three patients were found to have tears through the sphincter, to or into the anus. In many in tances a thin band or scar tissue lay over the hiatus. Tears running into the rectovaginal septum for from 0.5 to 3 rarely to 4 or 5 centimeters were found in 187 patients. One patient was found to have in addition a complete inversion of the uterus. She had had a forceps delivery 11 weeks before and had entered

TABLE I TYPES OF DELIVERY

	Number of cases	Percentage
One instrumental delivery	157	67.3
Two instrumental deliveries	43	18.0
Three instrumental deliveries	9	3.8
Four instrumental deliveries	5	2.1
Five instrumental deliveries	3	1.2
Six instrumental deliveries	4	1.7
One breech delivery	9	3.8
Two breech deliveries	1	0.4
Craniotomy (14 and 15 lb babies)	2	0.8
Foot presentation	1	0.4
Total	234	

the hospital because of flowing. Two months after operative restoration of the uterus, complete perineorrhaphy was performed. Two years four months later she was delivered normally of a full term baby.

Twenty one patients were discharged without operation. 1 was pregnant, 10 refused operation, and 10 were considered unsafe operative risks on account of old age, diabetes, pulmonary tuberculosis, or hypertension.

#### TREATMENT

*Preparation for operation* consisted of catharsis (one ounce of castor oil 24 hours before operation), a soapsuds enema and a boric acid douche 16 hours before operation and another enema 6 to 8 hours before operation. A light diet with plenty of fluid and carbohydrate was given.

*Operation*<sup>1</sup> In 74 cases in which the perineal separation was in the lateral sulci the first part of an Emmet operation was performed, i.e., the lateral sulci were denuded and sutures placed, thus uniting the anterior portion of the levator ani muscles to the sides of the rectum. In 196 cases in which the tear was in the median line and not along the sides of the rectum, either the first part of a Clark operation or a simple median triangular denudation was performed with catgut approximation from side to side, care being taken not to make the introitus too tight. When the tears extended far up the rectovaginal septum the denudation was begun above the upper angle of the wound and was carried down on either side to the Bartholin ducts, care being taken to remove only a small amount of tissue in the region of the introitus. The tear in the rectum was then closed with interrupted fine catgut sutures down to the anus after which the vaginal mucous membrane was approximated with interrupted catgut sutures to the introitus.

When the internal part of the operation was finished the external part was treated as follows: a

<sup>1</sup>Graves Gynecol. 27, 4th ed.

rectangular external perineal area with rounded corners was denuded, having as boundaries the two Bartholin ducts and the two dimples formed by the ends of the torn sphincter on either side of the anus. All scar tissue was dissected away. The bellies of the levators and the ends of the torn sphincter were brought into view by tenacula. Figure-of 8 sutures of No. 1 tanned catgut were then placed in both the levator and sphincter muscles, after which interrupted silkworm gut stitches were placed transversely from introitus to anus so as to include the skin levators, and sphincter, but not the rectum. The buried figure-of 8 stitches of catgut were tied so as to approximate but not constrict the levators and the ends of the torn sphincter. The silkworm gut stitches were tied so as to give approximation without tension and were then shotted and cut.

*Postoperative treatment* consisted in keeping the bowels closed for about 9 days, the diet consisting of fluids and soft solids with a low residue. After the bowels were opened, (castor oil by mouth and cottonseed oil by rectum) the silkworm gut sutures were removed.

#### COMPLICATIONS

Slight stitch sepsis occurred in the majority of cases but was of little significance since 89.3 per cent of the patients were discharged from 14 to 24 days after operation with perineums anatomically and functionally normal. One patient died 13 days after operation of mitral heart disease with decompensation (1907). Another patient perished well when discharged 24 days after operation, was readmitted 36 hours later and died of streptococcus septicæmia in 3½ days. The perineum had been severely traumatized by too early and brutal coitus (1905).

Deep stitch abscesses occurred in 10 patients and all healed within 6 months. Eight patients had a temporary rectovaginal fistula (1 to 3 millimeters in diameter) which did not give more than slight annoyance. One fistula cleared up in a year. A rectovaginal fistula large enough to demand operation occurred five times. It was closed successfully in the three patients who underwent operation.

Operation was a failure due to sepsis in 5 cases, 3 of which had been treated before 1902. A second operation was performed in two of these, with relief in one and cure in the other.

At the time of discharge from the hospital 4 patients were only relieved, i.e., there was some healing, but the anatomical and functional result was imperfect. A second operation cured 2 of these cases.

One patient cured at the time of discharge had an ischiorectal abscess when examined 2 years 3 months later. Two patients well after operation had a fistula in ano 2 years and 5 months, and 2 years and 10 months later, respectively.

#### RESULTS

In the consideration of a lesion of this sort it has been found that a good functional result indicates a good anatomical result. By 'failure' is meant that the local condition was at least no better than when first seen. 'Relieved' indicates an improvement. This covers the patients who had stitch abscess, rectovaginal fistula, fistula in ano or improved but not perfect function. By 'cure' is meant a satisfactory anatomical and functional result.

*Result at time of discharge from hospital.* Failure, 5 or 1.8 per cent; relieved, 24, or 8.9 per cent; cured, 249, or 89.3 per cent.

*Result three years after operation* (patients who became pregnant are not included). Traceable, 81. Failure, 1, or 1.2 per cent; relieved, 12, or 14.8 per cent; cured, 68, or 83.9 per cent.

*Result 5 to 25 years after operation* (patients who became pregnant are not included). Traceable, 56. Failure, 1, or 1.7 per cent; relieved, 8, or 14.2 per cent; cured, 47, or 83.9 per cent. Seven of the traceable cases died: (1) 1 year, 5 months of intestinal obstruction; (2) 1 year 9 months of lobar pneumonia; (3) 6 years, 5 months, of pelvic carcinomatosis; (4) 8 years 4 months, of heart disease; (5) 10 years 8 months of appendicitis; (6) 17 years of pulmonary tuberculosis; and (7) 25 years, of acute nephritis.

#### PREGNANCY AFTER OPERATION

Thirty-eight patients are known to have become pregnant after operation. Three were pregnant when seen 4 months to 2 years and 7 months after treatment and have been untraceable since. One to three miscarriages occurred in 5 patients, 4 of whom were well when traced 3 to 10 years after operation. The other was relieved one year later. Seven patients had one cesarean delivery, one had two cesarean deliveries, and one had four. Six of these were cured 1 to 11 years after repair at this clinic; three were relieved 12, and 16 years later respectively.

One patient died 8 years 8 months later (cause unknown) having had three more labors about which no information could be obtained. A second patient died of bronchopneumonia following labor during the 1918 influenza epidemic.

The 19 remaining patients had in all 30 children (20 were delivered normally and 10 with forceps).

and seven miscarriages. Normal deliveries resulted in recurrent complete tears in 6 cases, 3 of which were cured by further operation. A seventh patient had a recurrent tear following an instrumental delivery. Twelve patients, 4 of whom had had one or two instrumental deliveries, remained cured 2 to 19 years after their repair at this clinic.

#### SUMMARY AND CONCLUSIONS

1. A study has been made of 291 cases of third degree or complete tear of the perineum.

2. A history of abnormal delivery was given by 87.3 per cent of patients. Six patients stated that they had had convulsions with the pregnancy that resulted in a third degree tear.

3. Despite the high percentage of abnormal delivery and the comparative frequency of eclampsia, only 9 cases in the series are recorded as having been delivered in a hospital.

4. At the time of complete laceration, 64.6 per cent of the cases were primiparæ.

5. Seventy-three per cent of the patients were under 30 years of age and 41.3 per cent were under 25 when the complete tear was incurred.

6. The class of patient treated at this clinic may not be unduly inconvenienced by the loss of anal sphincter control. This is indicated by the fact that 22 patients did not complain of fecal incontinence at all, that a number complained only

of occasional inconvenience, and that 60 per cent at the time of admission, had had symptoms for 3 years or more up to 42 years.

7. Seventy-eight patients, 27.1 per cent of the series, had had in all 99 operations for third degree laceration before admission to this clinic. Twelve patients who had been cured or relieved had been torn again at a later labor. The remaining 87 previous repairs had been unsuccessful. Fifty-eight of these are recorded as having been performed immediately after delivery. Since then only 18.1 per cent of the repairs in this group were done under hospital conditions; it seems logical that the high percentage of failures was due to performing postpartum operations in patients' homes where it is almost impossible to maintain asepsis.

8. In those cases in which later pregnancy did not occur the results after operation at this clinic from the time of discharge to 25 years later were as follows: failures, 1 to 2 per cent; relieved, 8 to 14 per cent; cured, 83 to 89 per cent.

9. In those cases in which later pregnancy occurred the results were: recurrent tear, 21.2 per cent; partial recurrence, 12.1 per cent; remained cured, 66.6 per cent.

Note: to date there has been no decrease in the number of complete tear cases which have been seen yearly at this clinic.

## THE OBER OPERATION FOR CONGENITAL CLUB-FOOT

## END-RESULTS IN FIFTEEN CASES

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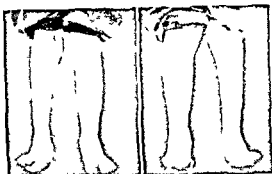
THE object of this paper is to report the results obtained by means of the Ober operation in the treatment of neglected or relapsed cases of congenital club foot. Fifteen operations were done on twelve patients. I shall also discuss the indications for this operation and its advantages over the more generally used cuneiform osteotomy.

The conservative or manipulative treatment, with possibly a local tenotomy in very resistant cases, has proved most satisfactory in the treatment of the early case. However it is not in the scope of this paper to discuss the treatment of congenital club foot in infants or very young children. Forcible manipulations followed by dressings to retain the improvement obtained by the manipulation is a step of great importance, regardless of the age of the patient or the severity of the deformity. At the outset it must be understood that a maximum degree of correction should be obtained by manipulation before there is resort to operation. The deformity involves the whole tarsus and is not the result of any local contracture. It is apparent therefore that at least some correction if not complete can be obtained by no means other than forcible manipulations. It is impossible by any open surgical operation to divide contractures of all the numerous ligaments and joint capsules present in all the tarsal and ankle joints.

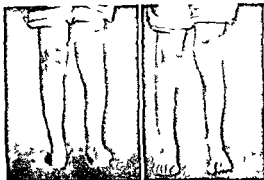
We may dismiss the consideration of the treatment of club-foot in infancy by the statement that open operation other than a local tenotomy is never necessary or advisable. In the more severe cases in older children or in case of relapse not yielding to manipulative treatment alone open operation must be resorted to in order to obtain a complete correction of the deformity. It is also the writer's belief that, while the time factor is not so important in a child, the duration under treatment is of great importance in the average case. Co-operation of the parents is essential for successful treatment, and if the duration of time the child is under treatment is prolonged, parents are often discouraged and impatient. As a result this reacts on the surgeon who may discontinue retentive dressings before the maximum degree of overcorrection has been obtained or who may not hold the overcorrection sufficiently long to prevent a relapse. After the manipulative treatment has

succeeded in overcoming the contractures in all except those persisting in a few well localized structures easily accessible to open operation a division of these structures through a skin incision is not only more complete but also causes less trauma to the soft parts and epiphyseal centers than do persisting attempts at tearing by brute force. A clean division of a ligament or joint capsule will result in less fibrosis and less subsequent contracture of the scar, and consequently less likelihood of relapse. In late years the injurious effect of trauma on epiphyses has repeatedly been brought to our attention, especially trauma to the head of the femur occurring during reduction of congenital dislocation of the hip resulting in later deformity of the head of the femur. The condition known as Legg's or Perthes' disease appears to be the result of trauma. It is conceivable, similarly, that deformities of the tarsal bones may result from persisting forcible manipulations. It appears to the writer that perhaps we have been too conservative in continuing manipulation after manipulation when an equally good result could be obtained by more gentle means and in a shorter period of time. On the other hand one can not be certain as to what harmful effect a simple procedure as tenotomy of the Achilles tendon may have in later life. It would be interesting to compare, in a series of cases in later life the effect on the Achilles group of muscles in cases in which tenotomy had been done with a series in which tenotomy had not been done. Similarly it would be interesting to investigate any deformity of the tarsal bones attributable to trauma.

Before proceeding to the rationale of any operative treatment a clear understanding of the pathological anatomy is essential. The deformity consists of inversion of the whole foot, abduction of the forefoot, and plantar flexion. In the newborn infant the bone changes are not present but soon occur with growth in accordance with Wolff's law. Before bony deformity has occurred the chief structures holding the foot in inversion are the contracted internal lateral (deltoid) ligament, the inferior calcaneoscapoid ligament, the plantar fascia, and the Achilles tendon. The Achilles tendon not only resists dorsiflexion of the foot, but in club-foot also acts as an inverter as it is found deflected toward the medial side. Of lesser im-



Figures 1 and 2 A severe valgus deformity resulting from too much overcorrection. Photographs were made 1 year after the Ober operation. This deformity was subsequently corrected by a subastragaloid arthrodesis.



Figures 3 and 4 Photographs 2 months after the Ober operation. In this case there was again a little too much overcorrection. The foot was manipulated under a general anesthetic and put up in plaster in the corrected position.

portance are shortened tibialis posticus and flexor longus digitorum tendons. These structures together with a contracted abductor hallucis muscle resist abduction of the forefoot. The contracted Achilles tendon is the chief obstacle to dorsiflexion. In the severe equinus deformity the contracted posterior portion of the capsule of the ankle joint resists dorsiflexion even after the Achilles tendon has been lengthened.

It is therefore apparent that in the operative correction of club foot attention must be directed toward the deltoid ligament, the inferior calcaneoscaphoid ligament and the Achilles tendon. If division of these structures fails to secure an overcorrection further lengthening of the tibialis posticus and the flexor longus digitorum tendons, and a division of the abductor hallucis muscle, must be done. If overcorrection of the equinus deformity can not be obtained following a lengthening of the Achilles tendon it will be necessary to do a capsulotomy through the posterior portion of the capsule of the ankle joint.

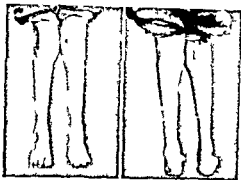
A general principle in all bone operations is to avoid injury to epiphyses in children. The late gross deformities following resection of tuberculous knees in children need only be mentioned to illustrate the calamity of inhibiting, or distorting growth of the epiphyses at the knee. This disturbance in growth of the tarsal bones is alone sufficient to condemn a wedge resection in young children. Except in an adult or in older children who have practically attained the maximum growth of the foot, this operation should not be considered certainly not before a preliminary Ober operation. In those severe neglected or relapsed cases in which it is apparently evident that bony deformity itself prevents correction, a preliminary operation directed toward the soft parts is advisable. This procedure alone will often

suffice in the borderline case. Again, by first obtaining a maximum correction by relieving contracted soft parts the extent of bone interference will be at a minimum. In children, if a bone operation is necessary after a relief of contractures of the soft parts has been obtained it is quite likely that a procedure along the lines of arthrodeses with the immediate corrective molding of the foot will be sufficient. The immediate postoperative result following a wedge resection is excellent. As growth continues, however, shortening of the foot becomes more pronounced. The writer has seen cases in which the valgus deformity has made an about face into a rigid foot in a valgus deformity. A wedge resection does not correct a valgus deformity of the os calcis which is essential to a permanently satisfactory result.

A procedure found by the writer to be satisfactory in the correction of club foot following the previous maximum correction by manipulations is that along the lines of the Ober operation which aims to attain overcorrection by division of the contracted soft parts. That complete overcorrection can be obtained is shown in Figures 1 and 2 that of a case in which too much overcorrection was obtained. It has never been my experience and in discussing the subject with others I have learned that it has never been their experience to obtain too much overcorrection. I therefore wish to call particular attention to this case. A note of warning is sounded, therefore, that the plaster dressing following the operation should not hold the foot in the maximum degree of overcorrection possible to be obtained.

#### THE OPERATION

The writer has made no attempt in the later cases to adhere strictly to the technique described



Figs 5 and 6 Postoperative result 4 1/2 years after bilateral Ober operations. The result is considered unsatisfactory as there still remains a light varus of the heels. It can not be regarded as a failure.

correction in the first plaster dressing because of circulatory disturbance resulting from stretching of the internal plantar artery. A few days later overcorrection can be obtained.

#### ANALYSIS OF RESULTS

It would be of no interest to report individually on each of the 15 operations. The ages at the time of operation varied from 23 months in the youngest child to 9 years in the oldest. All cases except one, were relapsed cases of club foot, or those in which persistent manipulations alone failed to obtain a cure. Two cases had had open operative treatment before. 10 cases had had subcutaneous tenotomy of the Achilles tendon, 3 cases had had plantar fasciotomy, and 1 case had had a wedge resection of the tarsus. At the time of the Ober operation the tibialis posterior tendon was lengthened and sutured in 3 cases, and completely tenotomized without suture in 9 cases. The flexor longus digitorum tendon was lengthened in 1 case, and tenotomized in 7 cases. The Achilles tendon was lengthened in 9 cases at the time of the original operation. Posterior capsulotomy of the ankle joint was necessary in 2 cases. The writer has not considered it necessary to delay lengthening of the Achilles tendon in these cases to a second stage operation because in all there had been previously a maximum degree of correction obtained by manipulative means. It was necessary to divide the abductor hallucis muscle in 4 cases to overcome varus of the forefoot. It apparently made little difference whether or not the ends of the lengthened tendons of the tibialis posterior or flexor longus digitorum were approximated by suture. A considerable degree of limitation of active and passive inversion of the foot remained in all cases. Active flexion of the toes returned in all cases. Apparently, in those in which the tenotomized ends were left separated adherence of the subsequent cicatrix to the tendon ends was sufficient to bind these tendons firmly. In one case in which too much overcorrection was obtained there resulted a contracture of the long extensor tendons of the toes. At operation 2 years later, to correct the valgus deformity it was necessary to lengthen these tendons. In another case (Figs 3 and 4) a similar but moderate contracture resisting physiotherapy persisted 2 months after the cast was removed. This was easily corrected by forcible manipulation and the application of a cast under anaesthesia. The Achilles tendon united firmly in all cases.

If the varus of the heel was corrected and the patient was able voluntarily to overcorrect the deformity, the result was considered excellent, if the

by Ober. I have proceeded along the line that every ligamentous structure resisting overcorrection is divided and resisting tendons are either lengthened or divided. A J shaped incision beginning posterior to the internal malleolus is made extending downward and curving anteriorly below the scaphoid bone. The flap formed is then reflected upward and anteriorly giving an exposure to the deltoid ligament and the calcaneo-scapoid ligament. The former is then completely severed from its attachment to the internal malleolus and detached subperiosteally from the astragalus to the os calcis and scaphoid. Injury to the vessels and nerve is easily avoided. As a rule immediately after this procedure the varus of the heel can be corrected. The thickened astragaloscaphoid capsule and the inferior calcaneoscaphoid ligament are now divided. As a rule this will permit eversion of the foot. The tibialis posterior tendon is generally seen to resist eversion and if so is tenotomized or lengthened. If abduction of the forefoot continues to be resisted, the abductor hallucis is cut through near its attachment to the os calcis. The foot is now forcibly manipulated to a maximum degree often accomplishing a tearing of a few remaining shortened structures. Finally, the Achilles tendon is exposed by the retraction of the tissues posteriorly and is lengthened. In case there is no great deformity of bone the foot can now be put into a completely overcorrected position. Occasionally there is difficulty in closing the incision without considerable tenseness of the skin at the line of suture. As a rule mobilization of the skin by prolongation of the vertical limb of the incision upward and undermining will prevent this.

It is well to heed the warning of Ober that the foot not be put up in the maximum obtainable

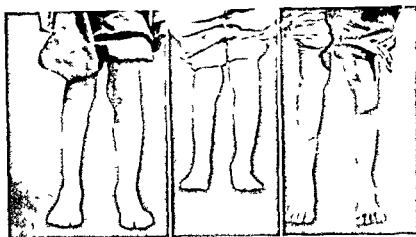


Fig 7

Fig 8

Fig 9

Figs 7 8 and 9 Examples of what the writer considers excellent results A slight overcorrection has been obtained

varus of the heel was corrected and the patient stood with no varus or metatarsus varus, even though a definite active overcorrection were not possible, the result was considered good A completely normal dorsiflexion of the foot was not considered essential Any remaining even though slight, varus of the heel or metatarsus varus was not considered a satisfactory result in spite of the fact that slight deformities of this nature caused no appreciable disturbance in function A result was considered a failure when complete correction was not obtained It would be desirable of course to obtain completely normal flexibility of the foot, but in all cases there remained at least some limitation toward inversion The writer believes that unsatisfactory results can not be attributed to the principles of the operation, but are due to imperfect technique Needless to say that in cases with gross deformity of bone the operation on soft parts alone will not be sufficient

End results following 15 operations reveal the following in 6 cases the result was excellent good

in 6 unsatisfactory in 2 and unknown in 1 Included in the unsatisfactory cases is the one of the severe valgus deformity Certain borderline results are difficult to classify according to any standard There have been no results which were regarded as failures Figures 5 and 6 show the result in a child in this borderline group, while complete correction has not been obtained, he walks with no appreciable limp or disability In no case except the one with the resulting valgus deformity has the result been sufficiently bad to require further operative treatment

#### CONCLUSIONS

The Ober operation has proved to be a very satisfactory procedure for the correction of congenital club foot not amenable to manipulations and retentive dressings

In resistant cases this operation can be done early without fear of subsequent disturbance in growth and the period of active treatment can be materially shortened



## EMBRYONAL ADENOMYOSARCOMA OF THE KIDNEY IN AN ADULT

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 From the Surgical Service of the Roosevelt Hospital

**E**MBRYONAL adenomyosarcoma of the kidney, though relatively uncommon, is well known and thoroughly discussed in the literature. The appearance of this tumor in adult life, however, is decidedly rare and it is on this account that we feel justified in reporting a case that occurred in a man of 48 years.

Embryonal adenomyosarcoma accounts for a large percentage of the malignancy in children, and the majority of the reported cases have been in infants. It has been found in the fetus, and its large size has been reported as a cause of dystocia. Ewing states that it is rare after the tenth year and usually found in the first 3 years. In a review of some 85,000 admissions to the Children's Hospital, Edinburgh, Fraser found several cases but none older than 6½ years. Kelly and Burnam found only two unquestionable cases in infants and Garceau found four. Other authors have likewise agreed that it is predominantly a disease of early childhood.

Between the years 1915 and 1928 there have been three such tumors in children at the Roosevelt Hospital. Their age varied from 6 months to 4 years. Nephrectomy was done in each case. One child died of recurrence in less than 6 months. The two others were living and well without evidence of recurrence 4 years after operation. Clinically and histologically the cases were typical of embryonal adenomyosarcoma of the kidney.

The usual clinical history is that of a rapidly growing tumor of the upper abdomen in an otherwise healthy individual. Pain may be a prominent symptom and is located in the flank, radiates to the groin, and is constant in character. Colic-like pain is present when blood clots are passed through the ureter. Hematuria is a less common symptom although it may be the first thing noticed by the patient. Digestive disturbances may be present. Loss of weight and strength, though not prominent in the early stages of the disease, combine with the great abdominal tumor to dominate the picture in the latter part of the course. Without treatment the disease is rapidly fatal but nephrectomy, if done early, will save some cases.

Urine analysis is negative unless there is hematuria. The pyelogram gives a shadow that is displaced by the tumor but not otherwise

altered in character until rather late when the tumor invades the kidney pelvis. Blood count shows the changes of anemia.

Histologically these tumors are classified as embryonal mixed tumors. Prior to the work of Birch Hirschfeld they had been considered as carcinomata but he definitely placed them in their present category. Subsequently the epochal study of Wilms further refined this classification. Indeed the name of Wilms is so closely associated with this neoplasm that it often goes by the terminology of Wilms tumor. It is also known as embryonal adenosarcoma, embryonal sarcoma, and embryonal adenomyosarcoma. The latter seems to be the most descriptive and is the name by which it is generally known at present.

Opinions as to its histogenesis have passed through various phases. Birch Hirschfeld considered the wolffian body as its probable origin. Wilms puts it at a later period but still very early as it must involve ectoderm and mesoderm and include nephrotome, sclerotome, and myotome. Muus considers that it arises from the renal blastema at an even later period and attributes the multiplicity of tissues to metaplasia. Ewing is inclined to agree with Muus as this concept affords the best explanation of the different forms assumed by the tumor.

Grossly these tumors are the largest of the renal neoplasms at any given time. They lie within the distended renal capsule and are usually sharply demarcated from the normal kidney tissue which is so pushed to the periphery that it forms a shell for the tumor. The growth is often solid, opaque and trabeculated although the larger tumors may be cystic or present hemorrhage and necrosis in their centers.

Microscopically the embryonal nature of the tumor cells is the most striking feature. The tumor is a true mixed tumor which always contains epithelial and connective tissue elements and usually smooth muscle in addition. Striated muscle, cartilage, and bone have been reported. A variety of epithelial types and arrangements may be encountered but the usual appearance is that of cylindrical or cuboidal cells grouped around a lumen so as to suggest an abortive renal tubule. These structures are supported by spindle cells in strands or broad sheets among which may be found collections of smooth muscle



Fig 1 Photograph of specimen Embryonal adenomyosarcoma of kidney

cells Different parts of the same tumor will show a varying preponderance of one type of tissue over the others Thus in some areas the appearance is that of an embryonal sarcoma with no epithelium present and elsewhere the tubular arrangement of the epithelium may be so striking as to cause confusion with the carcinomata

Metastases and extension are not the rule but do occur in a fair percentage of the cases Metastases may be of the carcinomatous or sarcomatous elements but, according to Fraser extension is always of the sarcomatous elements He contends that the earliest form of the tumor is preponderantly carcinomatous and that metaplasia occurs with age giving rise to the sarcomatous characteristics Hence metastasis may be of either type depending upon the nature of the tumor at the time it invades the blood stream or lymphatics but extension and infiltration being necessarily from the older parts of the tumor, must be sarcomatous The studies of our case do not entirely corroborate this idea The recurrence was entirely devoid of epithelial elements as far as we could determine but some of the sections taken from the extreme periphery of the primary tumor showed a great preponderance of epithelium which should not be present in this location if the theory is correct

Although predominantly a tumor of infancy, a few cases of adenomyosarcoma of the kidney have been reported in adults A careful search of the literature reveals 15 of these which are shown in Table I Some of them perhaps, may not have been embryonal adenomyosarcoma

Taddei thinks that Jenckel's tumor was benign MacDonald's case had a long ante operative clinical course which is not typical of the rapidly growing embryonal adenomyosarcomata, but the histological structure would seem to place it in this class Davis classifies the tumor in his case as adenomyosarcoma but the only epithelium he describes was cornified epithelium lining a large cyst Ewing describes similar epithelium in other embryonal adenomyosarcomata and as the other elements were typical we have classified it in this group In all the others the descriptions were of tumors that seemed to have the characteristics of embryonal adenomyosarcoma

Our own case which is reported here makes the sixteenth on record and was in a male of 48 These cases are too few for any accurate deductions to be drawn but there are two interesting features The first is that the cases are equally divided between the sexes, there being eight of

Author	Age	Sex
Hyman	22	Female
Muys	34	Female
Kocher and Langhans	35	Female
Albarran and Imbert	37	Male
Nicholson	40	Female
Jenckel	43	Female
Keefe and Palmer	44	Female
Hassner	45	Male
MacDonald	50	Male
Rohde	52	Male
Hedren	54	Male
Maas	55	Female
Baumann	59	Male
Thatcher and Fulmer	59	Female
Davis	59	Male

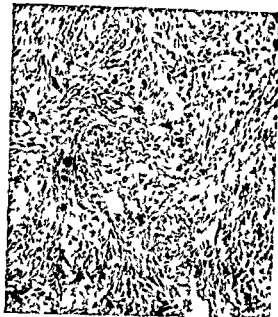


Fig 2 Sarcomatous area



Fig 3 Malignant epithelium in a malignant connective tissue stroma

each. The second is that 17, or 75 per cent occurred in the fifth and sixth decades of life, the recognized cancer age.



Fig 4 Two types of epithelium in same field. Note tubules.

#### REPORT OF CASE

O. K., a white male of American birth 43 years of age employed as a factory foreman was referred by Dr. Thomas Gallon on April 9, 1928. He gave a history of pain in the left flank of about 7 weeks duration and of hematuria of 3 weeks duration. The pain was rather constant in type non radiating and was associated with a feeling of abdominal distention. He had previously consulted another physician who made a diagnosis of digestive disturbance although the ingestion of food had never seemed to have any bearing on the pain. The treatment prescribed had no influence on the symptoms. He remained at his work which while not particularly hard entailed standing most of the day. Meanwhile he noticed a sense of weakness in the back on the left side and felt the pain nearly all the time. He states however that it was never severe enough to cause him any great concern. During this time his general health remained good although there may have been some loss of weight. Four weeks after the onset of the pain hematuria was noticed one morning at the first voiding and this continued at intervals alternating with clear urine. The blood was noted principally in the morning specimens. On a few occasions small blood clots were passed without pain and except for slight and occasional dysuria and increased frequency of urination no other urinary symptoms were noticed.

His past history was essentially negative. He had suffered no previous major illness and he had always enjoyed good health except for a tendency to catch cold frequently. These colds had always been easily cured. His family history contains nothing relevant to the present condition.

Physical examination disclosed a well nourished and developed adult white male who looks quite pale. Eyes, ears, nose and throat are negative. Chest has equal and

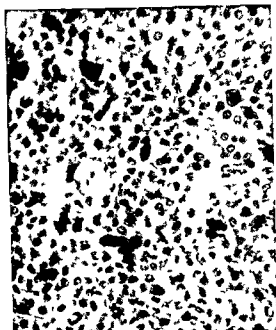


Fig. 5 High power of Figure 4 smaller epithelium

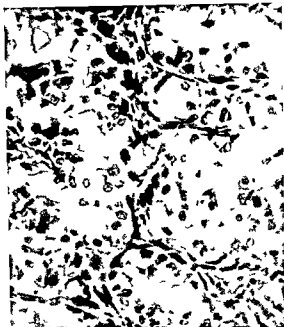


Fig. 6 High power of Figure 4 tubular epithelium

ample expansion with normal resonance and breath sounds. An occasional rale is heard over the left chest. There is no abnormal mediastinal dullness. The heart is not enlarged to percussion; the sounds are of good quality and no murmurs are detected. Extremities are negative; the knee jerks equal and active, and no areas of disturbed sensation are found. No tenderness is elicited in the lumbar vertebrae. There is a mass which can be palpated in the left upper abdomen, in the left flank, and in the left costovertebral angle. It moves with respiration but cannot be moved by manual palpation. It comes well below the costal margin in the mid axillary line. The surface contour is practically regular. The mass is not tender nor is there any abdominal spasm or rigidity. It gives the impression of being a kidney tumor. There are no other abdominal masses. Blood pressure systolic 140 diastolic 90. Urinalysis shows reaction acid, specific gravity 1.020, albumin very faint trace, sugar none, microscopic red blood cells, blood red blood cells 4,140,000, hemoglobin 75 per cent, white blood cells 6,200, polymorphonuclears 64 per cent. Blood Wassermann negative. Blood chemistry: Urea nitrogen 18.0, creatinine 0.20, uric acid 4.45, sugar 91.0, and salt 460.0, all expressed as milligrams per hundred cubic centimeters of blood. Roentgenograms of chest, spine and pelvis show no evidence of metastases.

**Operation.** On April 17, 1928 a left nephrectomy (E. F. K.) was performed. Curved incision was made from a point just within the tip of the last left rib to a point in front of the anterior superior spine of the left ilium. The kidney was found to be very large and because of this the application of clamps to the vascular pedicle was extremely difficult. The removal of the kidney after section of the pedicle was likewise very difficult because of the large size of the organ.

**Pathological examination.** Gross. The specimen consists of a large globular mass 16 centimeters in diameter

and weighing 980 grams (Fig. 1). It comprises a kidney with tumor attached. The renal pelvis and part of the ureter are present. The kidney is thinned and has become a shell around the tumor mass. The tumor is surrounded by a fibrous capsule sharply separating it from the kidney tissue. The tumor is gray friable and has a necrotic center into which there has been hemorrhage. The pelvic lymph nodes of the kidney are enlarged. Microscopic. The kidney tissue away from the tumor shows mild chronic changes. The interstitial tissue contains a few round cells. The glomeruli are congested and some of them are fibrosed. Some of the tubules contain casts and nearly all contain some exudate. Near the tumor the kidney tissue shows much compression. Sections of the tumor show a diversity of elements which are for the most part neoplastic and embryonal. Epithelial and connective tissue elements predominate, but there are a few places where smooth muscle may be distinguished.

The connective tissue elements have the appearance of rapidly growing sarcoma (Figs. 2 and 3). The cells are spindle shaped and contain large hyperchromatic nuclei with mitotic figures. The cells vary in size and tumor giant cells are frequent. The cells are arranged in delicate strands or broad sheets. Some sections are made up entirely of these cells while in others they act as a supporting stroma for the epithelial cells.

The epithelium is present in a variety of forms (Figs. 4, 5, 6 and 7). In some areas the cells are oval and arranged in solid cords. Here the cells have scant cytoplasm and large nuclei among which mitotic figures may be seen. In other places the epithelial cells are arranged more loosely; the cytoplasm is more abundant and they suggest the appearance and structure of the embryonal carcinoma of the testicle. Elsewhere the cells are tufted in their arrangement as though they were attempting to form renal glomeruli. In still other places the cells are cuboidal and have a distinct tubular arrangement suggesting abortive



Fig. 7 Oil immersion of Figure 6. Note strands of malignant spindle cells supporting tubules

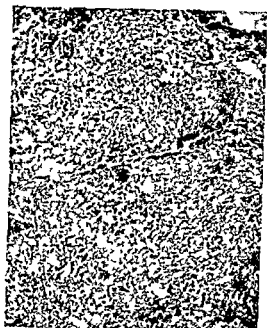


Fig. 8 Recurrence in sinus

renal tubules. In all instances the cells are distinctly malignant hyperchromatism is abundant and mitotic figures are found.

Smooth muscle is found in many of the slides in the form of slender strands and in no place is it abundant. With the hematoxylin-eosin stain it appears to be much more common than the differential stain proves it to be. Some slides are entirely devoid of it but it is found in the central part of the tumor as often as in the region of the renal pelvis. No striated muscle, bone or cartilage was found.

Some sections show a preponderance of epithelial elements and others show a preponderance of sarcomatous tissue but it does not appear that the periphery of the tumor contains the sarcomatous element to the exclusion of the epithelium. In one slide in which the capsule of the tumor is present it is at the extreme periphery the epithelium has a marked preponderance.

The blood vessels are small and well formed. Near the center of the tumor there is much blood pigment in the tissue.

**Diagnosis.** Embryonal adenomyosarcoma of the kidney.

**Course.** For the first 48 hours after operation the course was stormy necessitating the use of stimulants hypodermically and saline intravenously. After this recovery was without untoward symptoms except for more pain in the wound region than is usual due to a superficial infection. He was free from symptoms and had a normal temperature after the fourteenth postoperative day. He was discharged to his home on the twenty second day after operation with the wound clean and healed except for a small sinus.

During the following 5 weeks the patient gained 12 pounds in weight, the wound closed completely and his strength returned so that he again took up his old occupation. From then on however he began to fail and 3

months after operation a moderate hemorrhage occurred from the wound which had reopened. He was readmitted to the hospital on July 28, 1928.

Examination of the wound at this time showed it to be healed except for an area 2.5 centimeters by 1.2 centimeters surrounding the opening of a sinus. This area presented a reddened friable and readily bleeding surface which had the appearance of a skin recurrence. A hard non-tender mass which moved slightly with respiration was present in the left upper quadrant of the abdomen extending from above the costal margin to about the level of the umbilicus. Biopsy was taken from the sinus.

**Pathological report of biopsy.** Gross. The specimen consists of three pieces of tissue resembling granulation tissue. They are roughly 1 centimeter square and 2 millimeters in thickness. Attached to one is a bit of skin.

**Microscopical examination.** One section shows a layer of normal skin and a small amount of subcutaneous fibrous tissue. Below this is a solid mass of atypical spindle cells with pronounced variation in size and shape, arrangement and staining capacity. Most of the nuclei are densely chromatic and some are many times as large as others. There are many mononucleated and multinucleated giant cells. Many mitotic figures are seen. There are no attempts at alveolar formation and the epithelial elements prominent in the original tumor are lacking. The other elements correspond closely (Fig. 8). There is considerable infiltration of the tissue with round cells and polymorphonuclear leucocytes.

**Diagnosis.** Embryonal adenomyosarcoma of the kidney recurrent in sinus tract.

**Subsequent course.** From this time on the condition of the patient went steadily down hill with an increase in the size of the mass in the left upper quadrant. His death occurred 24 weeks after the operation and about 32 weeks after the onset of the first symptoms. Permission for

an autopsy was not obtained. At the time of his death there was no evidence of the tumor at any site other than the place of its recurrence.

Our thanks are expressed to Dr. James Ewing for examining the slides and confirming our diagnosis, and to Dr. Charles D. Lucas for his painstaking care in the preparation of the specimen and help with the photographs.

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# CORRESPONDENCE

## PANHISTERECTOMY TECHNIQUE

*To the Editor* Under the above caption in your July 1929 issue Dr J F Baldwin of Columbus Ohio has been kind enough to criticize specifically certain steps in my simplified technique for total removal of the uterus by the abdominal route published a few months ago.<sup>1</sup>

Inasmuch as these criticisms may lead to confusion in the minds of some regarding the merits of my operation I feel that it is incumbent upon me to answer them.

Objection is made first to that step of the operation described as Number 12 and illustrated in Figure 6 which deals with the separation of the rectum from the vagina on the ground that normally the rectum is not attached to the upper portion of the vagina and, therefore that this step is unnecessary.

My reply to this objection is that I have nowhere asserted that such an attachment normally exists. The established practice of draining abscesses in the cul de sac of Douglas by perforating the posterior vaginal fornix and the pelvic peritoneum would alone suffice to nullify such an assertion even had I fallen into the error of making it. But unfortunately normal anatomical relationships in the pelvis do not always obtain where panhysterectomy is required. Indeed, one frequently encounters pelvic pathology which has brought about not only an intimate attachment of the rectum to the upper vagina but to the lower cervix as well which must be intelligently dealt with prior to the completion of the panhysterectomy. I submit therefore that the step of my operation intended to meet exactly this situation should be included in the technique and properly described and pictured.

The second objection is based upon an interpretation of Figure 9 from which the conclusion is drawn that by my operation the vagina is necessarily shortened by nearly or quite an inch and that 'the shortening of the vagina must necessarily result in more or less dyspareunia and thus prove a fatal objection.'

*Surg. Gynec. & Obst.* 19 9 245 248

It is unfortunately true that the illustration in question might give this impression and I regret that this inaccuracy in the drawing escaped my notice prior to its reproduction. However Step 16 describes this part of the operation in detail and there is not a syllable in it that would justify such a conclusion. It is self evident that there would be no point in shortening the vagina by deliberately cutting away one inch of its upper portion. As a matter of fact the detachment is made as closely as possible to the cervix and consequently there is no appreciable shortening and no subsequent dyspareunia.

Third Dr Baldwin quite naturally prefers his own method of dealing with the uterosacral ligaments to mine. I greatly prefer my method to his for reasons clearly set forth in Step 17 of my article. Both methods having been published the profession is in a position to make its own choice and so the matter rests.

To my own testimony I am now in a position to add that of a widely scattered group of pelvic surgeons who have been kind enough to inform me of their adoption of my technique because they have found that it both simplifies the operation and reduces the hitherto troublesome hæmorrhage to a negligible factor. Thus far I have had no post operative infections in my series of cases.

EDWARD H. RICHARDSON

Baltimore  
Md

## HYDATID CYSTS OF THE LIVER — A CORRECTION

*To the Editor* Through an oversight I neglected to state the fact that the syringe mentioned in my article on *hydatid cysts of the liver* which appeared in the February 1929 issue of *SURGERY, Gynecology and Obstetrics* is a modification of the syringe known in France as the Deve syringe.

HAROLD DEW

Melbourne  
Australia

# EDITORIALS

## SURGERY, GYNECOLOGY AND OBSTETRICS

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NOVEMBER 1929

### SURGICAL PATHOLOGY AND MICROSCOPIC CANCER

MANY years ago William H. Welch said to me that when the microscope was first discovered, practically everyone who looked through this new instrument of precision and described minutely what he saw and published it, was a discoverer. This day has long passed. The new thing today is not the microscope but the fresh tissue removed in the operating room from the living patient.

William Mayo has often made the statement that the pathology, or rather the cellular pathology, so wonderfully developed by Virchow and the early general and surgical pathologists was dead pathology. Their well known published records describe and illustrate the stage of disease after death of the patient. These older pathologists had very little difficulty in distinguishing either by the gross appearance or from the study of the microscopic section, the benign from the malignant. When I studied in the great pathological department of Vienna in 1893, practically the only difficult microscopic diag-

noses were the distinction between inflammatory processes and sarcoma.

The enlightened individual who sees the value of periodic examinations and submits to a critical study the moment he or she is warned, will, when operated upon, present a pathological picture of a type that very few of the older pathologists or the younger pathologist trained in the older pathology, would recognize.

In 1912, seventeen years ago, I took a collection of sections of border line breast tumors largely types of chronic cystic mastitis and papillomatous cysts, to a few cities and asked a number of pathologists and surgical pathologists to study these sections with the microscope and write down their diagnosis, and whether they advised the removal of the tumor, of the breast, or the complete operation for cancer. The first was the largest group and met through the kindness and courtesy of Professor MacCallum in his laboratory in Columbia University. There was no uniform agreement. The diagnosis of malignancy varied from 20 to 60 per cent in the various localities. I have every evidence today to believe that in every single instance the breast lesion was benign. We mixed with these border line sections a few examples of scirrhus carcinoma and benign fibro adenoma and intracanalicular myxoma. There was no disagreement whatever regarding these.

Since 1920 the relative number of border line lesions in the breast and bone, cervix and body of the uterus, oral cavity and skin, stomach, colon and rectum, and now from the lung, has rapidly increased. Today there are not enough pathologists with the proper train-



ing to meet the demands for frozen section diagnosis in the hospitals of this country. Either there must be provision made for training these special surgical pathologists, or we must speed up research for a differential stain. Cancer is becoming a microscopic disease. Less and less can we depend on the clinical and gross pathological picture. Not only is it becoming a microscopic disease, but the number of early cases in which it is difficult or impossible to distinguish the cancer cell from the abnormal cell that is not yet cancer, has multiplied rapidly.

In the Surgical Pathological Laboratory of the Johns Hopkins University I am trying to meet both demands. In the new Garvan Research Laboratory we have organized for research for a differential stain. In the older laboratory we are offering a continuous course of microscopic study throughout the 4 years.

The diagnosis of pathological lesions through the microscope is largely a matter of memory, and this requires special training, continuous operation. One must work like great artists. There must be no letup in the practice. Every student should examine at least a dozen sections daily. Frank Mather, professor of art at Princeton, recently told me that he thought he had to memorize at least ten thousand photographs in order to learn how to distinguish the original masterpiece from a good but spurious copy. We have figured out that a surgical pathologist should memorize at least a thousand sections. There is first, the routine, and then the rare microscopic pictures, and for each routine or rare pathological lesion there are one or more atypical ones. For example, there is the routine typical giant cell tumor of bone and perhaps ten atypical smaller groups.

Dr. Broders from the Mayo Clinic recently visited me, and I asked him to look at a number of sections difficult to diagnose which were

waiting for my inspection, and I noticed he hesitated and took a much longer time than when I worked with him in his own clinic. I asked him what was the matter. He answered "I am out of practice. I have not seen a section for two weeks." The medical student who wishes to become proficient in the diagnosis of fresh tissue in the operating room must prepare by beginning the study of routine sections in the first year, even before he has had general pathology. He has had his histological training and this should continue throughout the four years. By the third year he should begin with frozen sections and some time during the fourth year should be spent with the pathological team in the operating room.

I began the teaching of surgical pathology 36 years ago and in the past 5 years the majority of the time of students in the laboratory was given to the study of microscopic sections. The clinical picture and the gross pathology so essential years ago, are becoming of less and less importance.

The significance of this is that in the diagnosis and treatment of cancer in its earliest stages, there will be a great demand for pathologists trained in microscopic diagnosis. The American College of Surgeons must use its influence with the medical schools and with the staffs of the great hospitals of this country and help them provide for a pathological team in the operating room as well as for an anæsthetic team in addition to the essential operating team, and now we also need a team for blood transfusion and the treatment of shock. It is often possible to combine pathologist and operator in one individual. This seems economically the best ultimate solution and it makes for a greater career for the pathologist to be an operator, and makes the operator a far more useful individual if he is a pathologist.

Should a differential stain be discovered, the pathologist may lose his job, but if he is also an operator, he will not

JOSEPH COLT BLOODGOOD

### AN INDICATION FOR EARLY OPERATION IN INTESTINAL OBSTRUCTION

ENTEROSTOMY is commonly performed as an emergency measure for the relief of intestinal obstruction occurring either as a secondary factor in a variety of intra abdominal, extra enteric conditions, or as the direct result of a lesion originating in the gut itself. The general opinion as to the merits of the operation is fairly well settled and this discussion is not concerned with them. It has proved, in our experience, a most valuable resource.

The high mortality reported following enterostomy is the inevitable concomitant of its use in already dying patients. It has been natural to delay interference until sufficient time has elapsed for the patient's condition to make operation imperative. This is the crux of the situation, for when we take as our criterion a condition that is no longer only potentially desperate, the sequel of enterostomy is apt to be a death from many factors too long evasive before operation even though action of the bowel be re established. Clearly, then, a new criterion for interference becomes necessary, one by which we can predict that the patient's situation will become desperate before that time actually arrives.

We believe that we have now such a criterion. Oddly enough, it devolved from a study of the methods of temporizing. The most effective non operative treatment for paralytic ileus at present is the injection of spinal anæsthetic. This is also applicable to many cases of partial obstruction of the mechanical type, such as the recurring and temporary obstructive crises of carcinoma of the colon and of old intraperitoneal inflammatory diseases. In the response to this treatment we have a true indication for or against enterostomy.

If within 15 minutes after the injection of the spinal anæsthetic, passage of gas and feces and disappearance of distention be not obtained, enterostomy should be performed immediately, thus taking advantage of the anæsthesia already produced. Longer delay permits progressive depletion of salt and water reserves, interference with circulation of the gut, absorption of toxin from the intestine, and the advancement of those other processes (the nature of which is still controversial) which singly or in combination cause death. After failure of response to spinal anæsthesia, expectant treatment alone, no matter how fortified by attempts to meet the patient's physiological needs, only delays the inevitable.

We have, then in spinal anæsthesia a therapeutic test which gives the indication that enterostomy will become necessary before the condition of the patient makes it evident.

WILLARD BARTLETT, JR

# MASTER SURGEONS OF AMERICA

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## LEWIS COLEMAN MORRIS

**L**EWIS COLEMAN MORRIS was a student, an educator, a leader in progressive movements in the interests of public health and hospitals, and a master surgeon. Though the span of his life was brief, the correct appraisal of it in service to his fellowman entitles him to first rank among the great surgeons, not only of the South, but also among the eminent surgeons of the generation in which he lived. He was a native of Virginia, the state which has given to the nation so many eminent men in education, in law, in statesmanship, in medicine and surgery. He imbibed the spirit of these great men. Tracing his life as a whole the great fundamental principle that guided it was that of preparation for usefulness.

He was a descendant of one of the most distinguished families of Virginia. He was born at Clazemont, Hanover County, Virginia, January 23, 1872. His grandfather, Richard Morris, of Taylor's Creek, Hanover County, a member of the Virginia Constitutional Convention of 1829-30, was a man recognized as a leader among the greatest men of his time. His parents were Edward Watts and Matilda Coleman Morris. His father was a member of the Virginia Constitutional Convention of 1850-51. His mother, a member of one of the leading families of Virginia, was related by birth to the Minors, the Maury's, and the Dicks. Lewis Coleman Morris, destined for a great career in any vocation, chose that profession in which he believed he could be most useful to his fellowman. While modest and unassuming, he appreciated his heredity, his environment, and his opportunities, and he made the most of them.

His early education was received at McGuire's School in Richmond, Randolph Macon College, Ashland, Virginia, and later in the University of North Carolina at Chapel Hill. His medical education was secured at the University of Virginia from which he graduated in medicine in June, 1892. His unusual work as a student was recognized by his Alma Mater in his appointment as demonstrator of anatomy. After one year's successful service in this position, he resigned and practiced a few months at Salisbury, North Carolina, but in the fall of the same year, 1893, he joined his brother, Dr. Edward Morris, in the practice of surgery in Birmingham, where he spent the remaining thirty years of his active and highly successful career as a leader and honored member of the medical profession in



LEWIS C MORRIS  
1872-1923

# MASTER SURGEONS OF AMERICA

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LEWIS COLEMAN MORRIS

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Alabama Dr Edward Morris was one of the most prominent surgeons in Birmingham and one of the most distinguished and learned members of the profession in Alabama He had a large and lucrative surgical practice Soon after these brothers began their professional work together they established the Morris Sanatorium which was successfully conducted until 1907 The death of Dr Edward Morris left Dr Lewis Coleman Morris a large surgical practice Dr Lewis Morris, though greatly grieved because of the untimely death of his older and devoted brother, entered with determination energy and enthusiasm into the professional work which had formerly been done by the two His success was remarkable from the beginning

At the outbreak of the Spanish American War in 1898, although busily engaged in his professional duties, he volunteered for service and entered the Army as surgeon of the First Alabama Regiment and served with distinction until peace was declared On being honorably discharged from the service he resumed his professional duties in Birmingham and was asked by Dr W E B Davis to become his associate in the chair of gynecology and abdominal surgery in the Birmingham Medical College—a notable honor and distinction for Dr Davis was a pioneer in this branch of surgery, and a man of national and international reputation This association continued until Dr Davis' death when Lewis Coleman Morris succeeded him as professor of gynecology and abdominal surgery

There are many things that mark Dr Morris as an unusual man It was evident from the beginning of his career in Birmingham that he had used well every possible opportunity in the preparation of himself for the study of medicine, that he had applied himself diligently as a student of medicine while in college, and that he had availed himself of and used well every possible opportunity for continuing his education after graduation One could not be associated with him without being impressed with his appreciation of the great men in the profession who had done such notable work in pioneering the way for all that is possible in the prevention and cure of disease It was his desire to do his full part in advancing the science and art of medicine and surgery and to maintain the high ideals of service and honor which had characterized the great and the noble in the profession who had contributed so much to its progress and elevation To better qualify himself to do this he did post graduate work at Johns Hopkins visited the great surgical clinics of this country, London, Paris, Vienna, and other European cities He perfected his own technique by operative work on cadavers and increased his experience in abdominal surgery on living anesthetized dogs He was as thorough in asepsis and antiseptis as careful in handling tissue and in the use of sutures and instruments in operating on dogs as he was in operating on the human His purpose was not merely to do the operation correctly but to get the dog well It gave him great delight to show the dogs operated on and to call attention to the fact that they were perfectly well



The insight and forethought of Dr Morris with reference to medical education was also demonstrated in the position which he took with the faculty of the medical school in 1906, when he urged that the entire property of the school, rights, and privileges including the contract with the Hillman Hospital, be given and conveyed to the trustees of the University of Alabama. He stated then clearly to the faculty that medical education should be conducted by the state universities or by highly endowed institutions. Most of the members of the faculty agreed with him, but at that time it was not possible to get all of them to agree to give the property, as aforesaid, to the University. In 1912 largely through the efforts and influence of Dr Morris, the interests of those members of the faculty who would not consent to giving the institution to the University were purchased and the institution—all its property, equipment, rights, and privileges—was given to the University of Alabama. At this time Dr Morris was elected dean in addition to his duties as professor of gynecology and abdominal surgery. Thus, all medical education in Alabama was discontinued except under the auspices and as a part of the University of Alabama.

Those who stand for the highest ideals in medical education throughout the country can appreciate the great service rendered by Dr Morris, his associates, and the University authorities in placing medical education in Alabama on a unified foundation, directed and conducted by the University of Alabama. This achievement stamps Dr Morris for all time as being a great leader in medical educational progress. He believed that medical education should be so standardized as to protect the public from men who, through ignorance or lack of professional knowledge and training, are not qualified to practice medicine but that state boards of examiners should not penalize reputable and capable physicians who have already demonstrated before a similar board having equal requirements and standards that they are competent to practice by requiring them to take an examination. "In all justice equity and fairness," said Dr Morris, "I cannot see why a man who has passed a satisfactory examination before a State Board having equal requirements with ours, whose character and standing is certified to by his State Board should not be accepted by us, whether that State reciprocates with us or not." The foregoing statement was made by Dr Morris in 1912 when he was president of the Medical Association of Alabama.

The prevention of disease was to Dr Morris a subject of fundamental importance to the very existence, civilization well being, and happiness of mankind. During his administration as president of the Alabama State Medical Association notable work was done in Alabama by the Rockefeller Hookworm Commission. He called attention to the fact that pellagra then constituted a serious menace to the people and urged an intensive study of the disease. He recommended the establishment of a State Hospital for the treatment of tuberculosis, and during his administration such a hospital was built at Wetumpka, Alabama. He urged



There are members of the profession throughout the South and other states who will ever be grateful to Lewis Coleman Morris because they were correctly taught the fundamental principles of gynecology and abdominal surgery and were inspired by his lofty ideals of preparation and service to higher attainments and greater usefulness. He was ever striving for greater facilities and better methods for teaching these important subjects. As a teacher he was clear, accurate, forceful, and interesting. His didactic lectures were thoroughly prepared and well delivered. In discussing a subject he emphasized the essentials and left out nothing that was important. He was kind, courteous, patient, and considerate, but most exacting in requiring each student to have a thorough knowledge of the subjects taught by him. The importance of the study of the individual patient by the surgeon as well as the internist was always emphasized. He taught that each patient should be thoroughly examined, and that in doing this the student should use his own eyes, his own fingers, his own judgment and that he should know as far as possible the complete history of the case and have all possible laboratory aids in reaching a decision as to the diagnosis. He believed and taught that didactic lectures were only helpful, and that the teacher who depended upon them without practical instruction on the cadaver and living tissue was not discharging his duty to those whom he taught. To supplement his lectures and the study of patients in the hospital and clinic, he required the students in groups to do operative work on cadavers, and also under his own direction or the direction of his associate to do operative work in groups on dogs. He required students of his classes to examine and study cases in the free dispensary. He taught that in case of a surgical mortality it was of the greatest importance that an autopsy be held.

Dr. Morris was intensely interested in medical education. He regarded the hospital—preferably the general charity hospital—as being a vital part of the teaching facilities of a medical college. His wisdom in association with other members of the faculty of the Birmingham Medical College in 1901 in forming an alliance between the college and the Hillman Hospital, which is the general charity hospital of Jefferson County, located in Birmingham, whereby the members of the faculty of the said institution appointed the staff of the said hospital to serve during each session, stamps him and his associates as being far sighted and correct in their plans for the proper use of the hospital in the practical teaching of medicine and surgery. At that time it was not possible to secure the continuous service for the entire year. The permanent contract with the hospital however, gave to the medical school indispensable teaching facilities for the scholastic year. Dr. Morris and his associates maintained that it was in the interest of the hospital and the medical school that the teaching faculty constitute the staff of the hospital as a continuous staff, and this was finally achieved when the medical school in 1912 became a part of the University of Alabama.

Dr Morris rarely went to public social functions but was happy in the social affairs of homes. He entertained in his own home in a unique manner. He gave house parties at his old home in Virginia and enjoyed entertaining his friends at his fishing camp on the river. He made his guests feel that they were at home and that he sincerely enjoyed having them. It gave him great pleasure when a number of his medical and surgical friends joined him on a hunting trip. He loved bird dogs—one of the most famous in the South, Lewis Morris, was named for him. It gave him great pleasure to take his sons to baseball and football games, and while he enjoyed the games, he enjoyed still more the association with his children. He played golf for exercise and recreation.

Lewis Morris is and will continue to be missed by his friends and colleagues. The wholesome influence of his life cannot be eradicated and will continue to do good throughout eternity. He was happy in the thought that he had been permitted to take part in the work of life. He realized that the illness with which he was suffering would possibly cause his passing suddenly at any time. Although conscious of this he did not alter in any way his mode of work and living. He was active in church work, being a member of the Episcopal Church, he believed firmly in the Christian religion and had no fear of death. It was not necessary for him to proclaim his religion. Those who knew him recognized that his views on all subjects were sane and well founded. His life testified that he was a true disciple of the One who said, 'Suffer little children to come unto me and forbid them not.' These vital principles were instilled within him by his parents from earliest childhood, and constituted the solid foundation of his life. In the most urgent and perplexing surgical emergency and in business, professional and social relations most provocative of anger, he was master of himself and the occasion. In a surgical emergency he did the correct and wise thing, in no relation did he show or give expression to anger or say aught against any one. His high attainments, lofty character, and great success made him free from thoughts of envy and jealousy, and caused him to take great delight in the success of his colleagues and friends.

Dr Morris was first married to Miss Susie Martin, a lovely and cultured member of a wealthy and influential pioneer family of Jefferson County, Alabama, who lived for less than a year and was survived by one daughter who died in infancy. In 1907 he married Miss Bessie Jemison, a daughter of Mr. Robert Jemison, a great industrial leader in Alabama. Her family is one of the most prominent, influential, and wealthy in the State, and were early settlers and developers of Tuscaloosa and Birmingham. His wife, a beautiful, attractive, cultured, and worthy companion, aided him greatly in his surgical progress and usefulness. He is survived by his wife and three children—Edward Watts Morris, Lewis Coleman Morris, and Miss Elizabeth Morris—who cherish and revere his memory.

the importance of the prevention of rabies and recommended the adoption of ordinances for the control of dogs in communities in which the disease prevailed. He believed that the State Laboratory maintained at public expense should be so adequate and efficient that *no hamlet in the confines of the State* would be so remote and no patient so poor that he could not without price or cost derive the benefits of modern laboratory findings. During his administration the State Department of Health inaugurated a system throughout the State by which diphtheria antitoxin could be secured at public expense for indigent patients. He recommended a system for legally requiring vital and mortuary reports from the members of the profession which he believed would cause Alabama to be placed in the registration area within 6 months. Thus we see a great and eminently successful surgeon advocating far reaching progressive public health measures of paramount importance in safeguarding the lives and making possible the happiness of the people as a whole.

At the beginning of his career in Birmingham he became a member of the Jefferson County Medical Society and of the Alabama State Medical Association. He was a member of the Birmingham Surgical Society, a Fellow of the American Medical Association, the American Association of Obstetricians and Gynecologists, the Southern Surgical Association, and the American College of Surgeons. He had been president of the Jefferson County Medical Society and the Birmingham Surgical Society. In 1910 he was vice president of the Southern Surgical Association. In 1912 he was president of the Medical Association of Alabama. He took part in all the active work of these societies and read papers which were timely and of great value and importance. Next to his family he derived his greatest pleasure, happiness and enthusiasm for his work from these meetings and the association with his professional friends.

At the time of his death he was consulting surgeon in Birmingham of the Southern Railroad. He had been for years, and at the time of his death was, a member of the staff of St. Vincent's Hospital, Hillman Hospital, and the Children's Hospital as gynecologist and abdominal surgeon. He was a member of the medical advisory board of Hillman Hospital and chairman of the board of The Children's Hospital. The Morris Memorial Hall, endowed by friends and former patients in the beautiful new building of the latter institution, stands as a lasting monument to his life of service in Birmingham. Indeed, his life work is embodied and enshrined also in the development and enlarged continuous usefulness of St. Vincent's Hospital and the Hillman Hospital. He was cordially welcomed in his professional work to all the hospitals in Birmingham. His unflinching courtesy, hearty cordiality, and marked appreciation of services rendered in behalf of patients, endeared him to nurses and the entire hospital personnel. His diagnostic ability, sound judgment and great surgical skill were recognized by his colleagues who frequently called him in consultation.



Truly the life of Lewis Coleman Morris, master surgeon, devoted husband, father, and true friend, is worthy of emulation not only by all who aspire to be master surgeons but also by all mankind. After having completed a busy day's work, he died suddenly on March 23, 1923, at the dinner table—in the arms of his close friend and secretary, Mr. W. J. Webb—surrounded by his devoted children, his wife being out of the city. No greater eulogy could be expressed on the life and work of any great soul than the words of the one who knew him best. "I feel that he fulfilled perfectly every relation of life."

C. P. HOGAN

# THE SURGEON'S LIBRARY

## OLD MASTERPIECES IN SURGERY

ALFRED BROWN M D F A C S OMAHA NEBRASKA

### RUFUS OF EPHEBUS

THE Christian Era opened on a world largely demoralized so far as science, including surgery was concerned. Greece was past history in leadership in culture and learning. Rome the ruler of the world had passed into a state of licentiousness bred of easily acquired wealth and power and as always under such conditions learning fell into the background. Cornelius Celsus, a learned Roman wrote on medicine and surgery but being of the upper class felt it beneath his dignity to practice and what he wrote was largely theoretical.

The great men of surgery must therefore be sought in other countries subjugated to Rome. It is true but far enough away so that the Roman yoke did not press heavily enough to prevent the exercise of some initiative and ambition. The most logical country in which such accomplishment is to be sought is the great near East where the three great cities Ephesus Smyrna and Pergamum, vied with each other to become the first city of Asia. All of these cities were subject to Rome but they fulfilled the condition of distance noted above.

Rufus always called of Ephesus though nothing is known of his life probably came from that city. When he was born is not known and his exact time cannot be determined accurately. It is generally assumed to be somewhere about the middle of the first century A D. He is referred to by Galen—hence he must have preceded him and was probably dead by Galen's time for the latter made it a rule not to mention his contemporaries. Rufus traveled some probably went to Rome, and surely went to Egypt for he mentions cases which he saw there. Among others he describes a disease called Ophitis the symptoms of which correspond with what is now known as Guinea Worm disease and one of the earliest parasitic diseases described. Rufus says:

This Ophitis thick as a piece of catgut twists and turns in the flesh like a reptile especially in the thighs and legs but also in other parts of the body. I have seen in Egypt an Arab affected with this disease when the patient wished to bend over he suffered pain then he was taken with fever a swelling like an abscess formed until finally the Ophitis rupturing the skin made its exit in pus and putrefaction.

The writings of Rufus that we now have are fairly complete and the method by which they have been collected is very interesting for many of them

have been obtained by quotations from other later writers and not directly from his manuscripts. Junius Paulus Crassus translated the Anatomy Concerning the names of parts of the human body from the Greek into Latin and published it in the *Medicæ Artis Principes* of Stephanus in 1567. The fragments of the 'Diseases of the Bladder and Kidneys' and 'Purgative Medicines' in the same work are by another translator whose name is not given. Rufus was however not only one of the first of the physicians of the Christian Era but also one of the greatest and served as a master for the later physicians to follow. The editions of his works however consisted only of fragments here and there some in manuscript and some in the quotations already referred to, until in 1851 Daremberg began his search to get them all together. He did not live to finish the task but the work was not allowed to drop and Ruelle with Daremberg's notes as a basis continued the task to completion. The result was published in Paris in 1879 under the title *Œuvres de Rufus d'Éphèse* and is a veritable mine of information.

Rufus was anatomist physiologist philosopher physician and surgeon, and withal a man of great common sense. As an anatomist he dissected the ape and described the optic chiasm. He noted that the nerves proceeded from the brain and divided them into two classes—the motor and the sensory. He discovered that the pulse had its origin in the heart and that the arteries as well as the veins contained blood. In surgery he was an active practitioner, for he states that he operated for the stone and describes his method. He also describes an operation he performed for fractured skull. But above all these where Rufus shines is in his article entitled

Concerning the interrogation of patients. In this he stresses the necessity of knowing all there is to know about the patient and his habits and to bear this in mind in the treatment of the case. As an example he says: It is necessary to ask the patient if he has or has not a good appetite if it is or is not altered and to inform oneself of the usual condition of each thing for it is not less important for the physician to be versed in the knowledge of the habits than in the nature of each indeed habitual food is less apt to harm than unaccustomed food which otherwise might appear to be of better quality it is necessary also to consider the manner in which food is customarily taken its quantity and its method of preparation. Rufus calls attention to many things which are of value today.

R V F F I E P H E S I I M E D I

ci de appellationibus partium corporis hu-  
mani, Libri III,

Eiusdem tractatus De vesicæ ac renum  
affectibus

Eiusdem fragmentum libri De medica-  
mentis purgantibus

*Horum librorum primus a Junio Paulo Crasso Latinitate  
donatus est, reliqui autem, duo ab alio*

THIS book *Chirurgie des Voies Biliaires. Spiro-Cholecystostomie*,<sup>1</sup> is a paper bound monograph of 120 pages. After 17 pages of text, mostly general material about gall bladder disease there follows the section on operative technique consisting almost entirely of pictures, many in color. It concludes with a summary of 50 cases. These case histories are too short to be of any possible value, and no follow up statistics are given.

The operative section the *raison d'être* of the monograph describes three methods of dealing with infected or stone containing gall bladders. The reviewer has not a doubt but that every sane surgeon would condemn all three methods as bad in every feature. The first method consists of ligating the cystic duct winding the end of the ligature around the gall bladder several times, and then sewing the gall bladder firmly to the anterior abdominal wall. The second is to skin the intact mucosa out of the gall bladder and sew up its outer coats leaving them in. The third is to split it in two and then to curette the mucosa of the part left on the liver and to sew up the remainder into a new tube. E A

SEMB'S book<sup>2</sup> on cancer of the breast was sent for publication February 1928. It is the most complete and best recent monograph on the subject. There are 472 pages. It is the most comprehensive review of the literature since the publication of Deaver and McFarland, on the breast.

There are certain omissions however. He has failed to find my most comprehensive study<sup>3</sup> on the pathology of chronic cystic mastitis of the female breast with special consideration of the blue domed cyst although he gives reference to two later articles of mine in 1922 and 1924. It is unfortunate because the conclusions in my article in 1922 strongly favored that chronic cystic mastitis is not a precancerous lesion. When cancer occurs in this benign lesion of the breast, it is an incidence and not a consequence and I have just sent for publication further studies—four articles—confirming this view of 1922.

The author Carl Semb comes to the conclusion after the study of his cases that chronic cystic mastitis is a precancerous lesion and that it is safer to remove the breast even when there is no microscopic evidence of cancer. To repeat my conclusions are the exact reverse. This former first assistant in the Pathologic Laboratory of Professor Francis Harbitz has based his studies on 144 cases which represent the entire material of fibro adenomatosis mammae received during a period of two and one half years from a great number of surgeons and clinics. He therefore is dependent upon other clinics and surgeons for the clinical history and the

follow up. I have been studying this disease for almost 40 years. My first publication was in 1906 when I fell into the same error with Reclus and Schimmelbusch in concluding that at least the diffuse type of chronic cystic mastitis in which large blue domed cysts are conspicuous by their absence and in which the predominant microscopic picture is diffuse papillary cystadenoma and irregular adenoma are precancerous lesions. Semb calls diffuse, irregular adenoma *fibro adenomatosis simplex* (his Fig. 3) and papillary cystadenoma *fibro adenomatosis cystica*. He presents 23 photographs, while I presented 40. This is evidence that he has not presented the entire microscopic possibilities. It is my opinion that two and one half years with an experience of 144 cases is not sufficient to establish the relation of this disease to cancer. If one will glance over the literature as so well reviewed by Dr Semb and with which I have been familiar since 1906, one will find that the authors who have had the longest experience in years and in the larger number of cases express the opinion that chronic cystic mastitis has no relation to cancer. Billroth and Velpeau belong to this group while others base their conclusions on a few cases and over short periods of time. Sir Ashley Cooper in 1888 observed one cancer in 12 examples of cysts of the breast.

The chief element of error is the misinterpretation of the microscopic appearance of certain stages of this parenchymatous disease. I now have at least 300 examples of this lesion of the breast which have been diagnosed cancer in some clinics and by one or more pathologists. The axillary glands have not been involved and there has been no recurrence and the patients have not died of cancer.

We must look upon this monograph of Carl Semb as a very important contribution to the literature from every standpoint and a fine example to the younger men in the various clinics throughout this world. In every clinic there is the material and the available literature. The things needed most are enthusiastic young men and women who are willing to do the work. The cause of chronic cystic mastitis is still unknown. I trust that those who read this book will also read my contribution in the original and thus if possible save their patients whose breasts are the seat of this benign disease from any operation at all or from the loss of the breast after the excision of a zone and frozen section study. In my clinic of the 65 per cent of women who have lesions of the breast for which operation is not indicated the clinical picture suggests chronic cystic mastitis in more than one half of the cases. They are grouped clinically in multiple tumors in one or both breasts unilateral or bilateral lumpy breast or shotty breast and those with worm like masses beneath the nipple. The most common single tumor of the breast in the group of one month's duration is the blue domed cyst or a non encapsulated area of chronic cystic mastitis. In both of these groups too many breasts are sacrificed because of the difficulty

<sup>1</sup>CHIRURGIE DES VOIES BILIAIRES. SPIRO-CHOLECYSTOSTOMIE. By C. SEMB. Paris. 1928. 120 p. 12.50.  
<sup>2</sup>THE PATHOLOGY OF CHRONIC CYSTIC MASTITIS. By C. SEMB. New York. 1928. 120 p. 12.50.  
<sup>3</sup>THE PATHOLOGY OF CHRONIC CYSTIC MASTITIS. By C. SEMB. New York. 1928. 120 p. 12.50.



## REVIEWS OF NEW BOOKS

**T**HE *Injection Treatment of Internal Hemorrhoids*<sup>1</sup> by Pruitt is a very clear and concise treatise on the non surgical treatment of hemorrhoids. The first chapters are devoted to the anatomy and to the pathology which offers the field of this treatment. The etiological factors which lead up to this condition are usually occupation, age, sex and last but not least, heredity. The pathological change that we find in the hemorrhoidal veins is in a manner similar to that occurring in varicose veins in other parts of the body. This is clearly shown and illustrated by Quenu's classical description of the pathological changes in the hemorrhoidal veins.

Before taking up the treatment, the author gives a detailed description of the different forms of hemorrhoids that may be encountered, their complications, their clinical symptoms such as bleeding, prolapsing, itching, mental depression, and pain. It is clearly pointed out that this latter symptom of pain occurs only when infection or strangulation has occurred. The method of injecting hemorrhoids was first used by Edwards in England nearly a half century ago. He kept it a secret and sold it to individuals, some of them non medical men, who traveled about the country and called themselves 'Pile Curers'. Since this method was so viciously exploited at its very beginning it is no wonder that it was frowned upon by the medical profession. From various sources we learn that it was first used in this country about 1875 by Mitchell of Clinton, Illinois. He used a solution of carbolic acid of about 33 per cent. At the present time all old prejudices have been cast aside and forgotten and this method of treatment has been given due credit. Although it has not wholly replaced the operative treatment it is frequently used by reputable proctologists. The technique of operation, the after treatment, as well as the advantages and disadvantages are fully discussed. The final result of both methods depends largely upon the skill, experience, and judgment of the operator.

C. J. DE BEEF

**T**HE book entitled *Studies on Malaria*<sup>2</sup> is in brief an autobiography of the discoverer of the source of malaria. It has been an inspiration to read this little book. It is the direct statement of his life work by a man utterly devoted to science. All those who struggle in the dark with the unseen enemies of health should read it and take comfort from it.

In these days the research worker is supported by extensive endowment funds and is encouraged by the repeated successes of modern science. The contrast that Ross and other early pioneers offer is most forceful. Ross worked alone in his little regimental

hospitals at various stations in India from 1889 on, and finally in 1897, discovered the parasites in an anophelid mosquito which he had fed on a malarial patient. The rest of his life was devoted to study of the problem but chiefly to a struggle for practical malaria prevention by mosquito extermination. Gorgas' work at Havana and Panama was a direct development of this.

The book has many interesting contacts. It contains a long letter to Lord Lister, several accounts of the British Empire builder Sir William MacGregor's trip to America when he met Gorgas and a delightful incident with Osler, and because of these forms a valuable addition to the history of the growth of modern medicine. In addition there is throughout a discussion of the malaria problem. It is difficult for us to appreciate the importance of this disease of the tropics where it causes probably one or two million deaths every year besides an immense amount of persistent sickness. The book is concluded by a chronological list which contains 108 references on malaria.

From every point of view this book is worth reading—as a stirring personal story, as medical history, as an example of scientific method and as a source of information on a great health problem.

PAUL STARR

**T**HE Oxford monographs on diagnosis and treatment are moderate in size and the subjects are simply but adequately covered by recognized authorities. The first volume on *The Diagnosis and Treatment of Disorders of Metabolism*<sup>3</sup> is a general discussion of disorders of metabolism including the measurement and variations in normal metabolism, disorders of intermediary metabolism, disturbances of water balance with special reference to anhydremia, oedema and diabetes insipidus, acidosis and alkalosis, gout, obesity and diabetes mellitus. I am impressed with the practical and explicit way in which Dr McLester has elucidated these subjects. Modern surgical management requires that one have a thorough understanding of these fundamental facts of metabolism.

The discussion is characterized by details of technique so that this book becomes a clinical handbook which might well be supplied to internes and be studied by all interested in the immediate management of patients. The basic metabolic condition of patients is certainly of pre-eminent importance in pre-operative and postoperative care. This work gives specific directions for the control of anhydremia, oedema and acidosis and alkalosis. It will be found valuable by the surgeon as well as the internist.

PAUL STARR

<sup>1</sup> *INJECTION TREATMENT OF INTERNAL HEMORRHOIDS*. By Marion C. Pruitt, M.D., L.R.C.P.S. (Edin.), F.A.C.S. St. Louis: The C. V. Mosby Company, 1930.

<sup>2</sup> *STUDIES ON MALARIA*. By Sir Ronald Ross, K.C.B., K.C.M.G., F.R.S., F.R.C.S. London: John Murray, 1910.

<sup>3</sup> *OXFORD MONOGRAPHS ON DIAGNOSIS AND TREATMENT*. Edited by Henry A. Chastain, M.D., Sc.D., LL.D., Vol. I—*The Diagnosis and Treatment of Disorders of Metabolism*. By James S. McLester, M.D. New York: Oxford University Press, 1930.

ADEQUATE pre-operative and postoperative care of surgical patients has helped to avoid many a fatality and has rehabilitated many post surgical risks. And yet an almost helpless attitude has characterized the management of patients afflicted with postoperative thrombosis and embolism one of the most feared complications in surgery. In a recent monograph<sup>1</sup> Professor Ducuing has given a complete description of the anatomy, pathology, and physiology of phlebitis, thrombosis, and embolism. The correlation of these fundamental principles with detailed clinical observations is the outstanding feature of the book. The frequency of such complications—225 cases of phlebitis and 300 cases of embolism in 3,000 operations—must make the reader feel that either he has frequently overlooked slight manifestations of phlebitis and embolism or that the author's increased attention to the subject has influenced the interpretation of minor symptoms. The study of the case histories, however, justifies the author's percentages. The statistical study of 3,000 personally observed cases is far more impressive than any other collective material it enabled him to detect early signs of phlebitis; he has thereby materially reduced graver complications. An attempt has also been made to diagnose the location of venous obstruction by the appearance of small areas of edema, by faint cyanosis particularly after exposure to cold and by the absence of the pilo motor reflexes.

Some of the author's experimental work is incorporated in this book. He seems particularly interested in the supposed venous spasm following thrombosis and brings proofs of this contention. Also the effect of leeches on the production of thrombosis has been studied. Ducuing's attitude toward the use of leeches in the prophylaxis and treatment of postoperative phlebitis is very skeptical. There has been a renewed interest in this form of treatment in many continental clinics. The author's clinical observations carefully controlled do not warrant their use.

There are many valuable suggestions for the prophylaxis and treatment of these conditions but most important of all is the early recognition. A systematic search for early symptoms may help to avoid serious complications. Iodo-ureteric vaccination is given an important rôle in prophylaxis.

The diagrams and photomicrographs are very lucid, a more concise handling of the subject matter would avoid unnecessary repetitions. The bibliography is of unusually wide and polyglot scope. As a whole this is a most original and inspiring contribution, it deserves wide recognition. GÉZA DE TAKÁTS

AS the title *Clinical Electrocardiograms Their Interpretation and Significance*<sup>2</sup> implies this

<sup>1</sup>PHLEBITIS THROMBOSIS ET EMBOLIS POST-OPERATOIRES. By J. DUCUING. Pp. 1. Masson Et Cie. 1929.  
<sup>2</sup>HAND CLINIC MONOGRAPHS. CLINICAL ELECTROCARDIOGRAMS THEIR INTERPRETATION AND SIGNIFICANCE. By F. EDERICK A. WILLIAMS. Pp. 112. M. S. Philadelphia and London W. B. Saunders Company 1929.

book is made up almost entirely of illustrative electrocardiograms. The author has not attempted to discuss the subject of electrocardiography in general. In his preface, indeed, he disclaims any attempt to discuss the technique or theory of electrocardiography or controversial questions. The text accompanying the electrocardiograms is brief and devoted almost entirely to elaboration of the legends which accompany the various figures. If there is any fault to be found with the book it would be in connection with the scanty discussion of the principles of electrocardiography. It appears to the reviewer that the value of the book might be considerably increased if the text were more complete. As it is the man with limited experience of the subject will find many valuable electrocardiograms including illustrations of all the varieties commonly met with in clinical work. The author has drawn these from an exceptionally large collection and has a background of a wide experience in the clinical application of electrocardiography. These numerous electrocardiograms, backed by this experience, serve to make the book useful to any student of electrocardiography and particularly to those who may happen to be working more or less alone with a subject which is comparatively unfamiliar to them.

The clinical aspects of electrocardiography have indeed been presented completely in the graphic manner designed by the author. Some sections, such as those on ventricular tachycardia and the chapter on individual wave changes, are especially interesting and valuable.

JAMES G. CARR

AN ambitious work of 1,100 pages in 4 volumes on *Surgical Diagnosis*<sup>3</sup> by A. J. Walton is well printed and unusually carefully bound to withstand hard use as a student's textbook or a desk manual for the practitioner. The contributors are with one exception British surgeons, and all are men known to be authorities in the fields on which they write. Not only general surgery but all the surgical specialties are included.

In the introduction the editor deplores the present tendency to lean too heavily on the laboratory for diagnoses and throughout the work the stress is laid on careful clinical work with the special diagnostic methods to be used only as confirmation of conclusions already tentatively reached from the clinical examination. While the quality of the material naturally varies with so many authors the standard is uniformly very high and there is a strong tendency to simplify the discussions and reduce them to the clearest and least complicated terms. Principles rather than details are emphasized throughout and as a result one is surprised to find what an enormous amount of subject matter has been compressed into a small space.

While space does not permit a detailed discussion of each contribution a few are so outstanding as to

<sup>3</sup>A TEXT BOOK OF SURGICAL DIAGNOSIS. Edited by A. J. W. Walton, M.S., F.R.C.S. B.Sc., M.B. Vol. 1 and 2. New York: William Wood and Company 1928.

of interpreting the microscopic pictures from cancer, or because the operator or pathologist is of the opinion that chronic cystic mastitis is a precancerous lesion, and that it is therefore safer to remove the breast

JOSEPH COLT BLOODGOOD

**A** SUMMARY of the six lectures delivered by Crile at the University of Washington in 1927 is found in *Problems in Surgery*.<sup>1</sup> They are on totally unrelated subjects and have all been published before in other form. The first paper is on the management of acute infections and contains much sane advice to the young surgeon. The use of antiseptics is not encouraged, but stress is laid on the physiological mechanism by which the body normally combats infection. Rest is especially emphasized meaning absolute rest—the putting of the mind as well as the body of the patient at the greatest possible ease. Heat, fluids, a blood transfusion, if necessary, and morphine are the cardinal points. Especially valuable is the advice not to disturb unnecessarily the patient by giving useless stimulants, vaccines, antiseptics, and other fads. A more or less general discussion of carcinoma is given with clinical examples and the diagnosis and operative technique.

The most interesting features of the book are the papers on the operations on the bad risk patient and on the mechanism of hyperthyroidism. Both of these contain physiological discussions as to just what constitutes the bad risk case and what fundamental metabolic disturbances are involved in the various types. The inter relation of the adrenal and thyroid, the effect of loss of heat to the brain and the effect of various toxins on the cells of the brain in numerous conditions are discussed. In a series of graphs the effect of prolonged ether anesthesia on the temperature of the brain and the pyrexia of the liver is shown. The fall is so great that it must be clear to anyone that the activity of the cells is markedly impaired and that ether anesthesia is therefore contra indicated in such cases. Crile's use of the diathermy to counteract this effect is how ever to say the least, open to discussion.

The whole work makes very interesting reading. It is packed full of practical suggestions based upon the enormous experience of the author and shows throughout his great enthusiasm for scientific investigation.

EDMUND ANDREWS

**I**N preparing the volume on *Surgical Pathology*<sup>2</sup> the authors have attempted to put forward such an account of the pathological side of surgery as may help readers in their clinical work. They have endeavored 'to trace the pathology of each surgical disease from its inception. These purposes have been satisfactorily accomplished. The first 162 pages deal with general the remainder of the 604 pages

with special surgical pathology. The section on general surgical pathology is brief, but the authors have the rare faculty of compactness of expression, so that the subjects are adequately discussed for the group of readers for whom the book is primarily intended namely practicing surgeons and students who have had the regular course in pathology. The subject of inflammation is discussed in 7 pages but these furnish an excellent review of the fundamental changes that occur in inflamed tissues. The subjects of special surgical pathology are not all considered with equal completeness nor with equal facility. Perhaps the best part of this portion of the book is that which deals with the pathology of bones and joints. This was, perhaps to be expected inasmuch as the junior author is an orthopedic surgeon. In considering diseases which are not specifically surgical the reader is referred to works on medicine and pathology.

The typography is clear and no glaring typographical errors have been encountered. On page 782 is the statement that adrenal rests 'are found under the cortex of the kidneys.' They are actually found immediately under the capsule. Pathologists who consider Hodgkin's disease as a lymphogranuloma would hardly approve of classing it as a lymphadenoma. The illustrations are well selected and, on the whole, fulfill their purpose well. In many instances the microscopic picture accompanies the gross appearance of the pathological condition under consideration. Illustrations of bacteria are inserted as inch-square insets. Reproductions of roentgenograms are used very effectively especially in the chapters on the pathology of bones and joints. Of special value are the diagrams which show the routes of spread of infection in different organs and parts of the body and the lymph drainage of the breast. The index is admirable and comprises 39 pages thus making reference easy. Much unnecessary repetition is avoided by means of an excellent system of cross references which are found in the text. There is no bibliography.

J P S

**PENBERTON'S** work<sup>3</sup> consists of 340 pages devoted to a study of the various phases of the problem of arthritis. It represents for the most part the personal experiences of the author with a very large number of cases of arthritis of various types treated by him during and since the War. He makes a concise presentation of his own experimental and clinical observations and at the same time makes free use of the published reports of other workers in this field. The work accomplishes the purpose for which it is intended in that it connects Penberton's own observations, it correlates them with the work of other students, and it presents to the general practitioner in a practical way such information as will aid him in the treatment of patients suffering with arthritis.

W H H

<sup>1</sup> PROBLEMS IN SURGERY. UNIVERSITY OF WASHINGTON GRADUATE MEDICAL LECTURES, 1927. By George W. Crile, M.D. Philadelphia and London: W. B. Saunders Company, 1928.

<sup>2</sup> SURGICAL PATHOLOGY. By Cecil F. G. Wakley, F.R.C.S. (Eng.) F.R.S. (Edin.) and St. J. D. Buxton, M.B. B.S. (Lond.) F.R.C.S. (Eng.) New York: William Wood and Company, 1929.

<sup>3</sup> ARTHRITIS AND RHEUMATOID CONDITIONS: THEIR NATURE AND TREATMENT. By R. John Penberton, M.S., M.D. Philadelphia: Lea & Febiger, 1929.

achievement based upon theory and vision is Dawkes' book on the medical museum. The functions of a medical museum are discussed and the details of the new system of visual teaching on which the medical museum is based are described.

Everyone interested in museums whether in regard to construction, development, control or use should read and study this book. Having done so there will be a natural desire to see its methods developed in actual practice.

**THIS** volume on *Diseases of the Liver, Gall Bladder and Bile Ducts*<sup>1</sup> is widely known through two previous editions. The text is divided into four parts, one, diseases of the liver, two, diseases of the biliary tract, three, diseases of the gall bladder and four, diseases of the bile ducts. There is a short section on radiological diagnosis and methods of bilirubin estimation.

Three-quarters of the book is devoted to diseases of the liver. Chapters on anatomy, physiology and abnormalities appear first in the book and others on diseases of the hepatic artery, portal veins, infarcts, hepatitis, abscess, cirrhosis, syphilis, tuberculosis, cysts, tumors and jaundice follow. The material presented in this section is as complete a piece of work from a pathologic and clinical standpoint as can be found in the literature. In the concise direct method of description and excellent English of the authors one is frequently reminded of Osler's *Single Volume Medicine*.

The section on gall bladder and bile ducts is presented in much the same fashion as that on liver. This is not a surgical text and treatment is given but slight attention. If there is any criticism of this section it is that no attention is devoted to the diagnosis of early and mild cholecystitis. Viewed as a whole however, this volume is considered one of the outstanding contributions to the literature of liver and bile ducts.

J. R. BUCHBINDER

**STFINDER** is a man peculiarly well qualified to write on *Diseases and Deformities of the Spine and Thorax*<sup>2</sup>. His knowledge of English, French, German and Italian orthopedic literature is unusually intimate and complete. The subject is of importance to every orthopedic surgeon. The presentation of the material is excellent as is the sequence of the subject matter treated.

Emphasis has been placed upon the proper subjects. There is much originality in the book which reflects the author's intensive study and research work on the conditions discussed.

His choice of illustrations is excellent and the execution of them is on the whole very satisfactory.

<sup>1</sup>THE MEDICAL MUSEUM: Method in Development. Organized on a definite plan. By H. Dawkes. 1920. 100 pp. 10s. 6d. London: The Medical Museum. 1920.

<sup>2</sup>DISEASES OF THE LIVER, GALL-BLADDER AND BILE DUCTS. By S. R. F. C. P. 1920. London: Macmillan and Company Ltd. 1920.

<sup>3</sup>DISEASES AND DEFORMITIES OF THE SPINE AND THORAX. By Arthur S. Finder. M.D. F.A.C.S. St. Louis: The C. V. Mosby Company. 1920.

Numerous roentgenograms, line drawings and anatomical sketches should be of value to the reader.

The subject of congenital deformities of the spine and thorax has been treated extensively, and the chapter on spondylolisthesis has been very well done. In the chapter on scoliosis, the author has referred to practically every good article that has appeared in the literature. In addition, he offers the results of his own extensive research and intensive study. He includes the Galeazzi method of treatment of scoliosis.

Fractures and dislocations are given a good sized chapter. The chapter on low back pain is worthy of the attention of every orthopedist, gynecologist and industrial surgeon. Tuberculosis and osteomyelitis of the spine are discussed as are syphilis and arthritis of the spine. Tumors of the spine are included in one chapter and a synopsis of the anatomy of the spine in another.

The author has been fortunate in having the advice and help of Dr. H. J. Prentiss concerning all anatomical questions.

The work of the publisher is well done. The bibliography is comprehensive and well organized. This book should be of great value to the orthopedist, the pediatrician, the neurologist and the physical therapist. In it the practitioner will find an encyclopedia of information concerning the subjects treated.

PHILIP LEWIN

**W**ARTHIN'S small volume on *Old Age*<sup>1</sup> will be to the middle aged a stumbling block to the youthful foolishness. The latter will be unable to comprehend how the phenomena of the major involution herein described can be applied to him. The former will be more or less stunned by the realistic description of the aging process. He will therefore stumble but he need not fall and the remainder of his journey may be made easier and more satisfying for having read this book.

The underlying idea is expressed by the author in the following paragraph quoted from pages 76 and 77.

We are defending the thesis that *senescence* is a normal involutionary process, and its underlying laws and phenomena are essentially identical with those of the minor involutions of the growth period of the organism. The main differences between the minor and the major involutions are those of degree, purpose and the organ or tissue involved. The minor involutions affect single specialized structures that are more or less temporary in function and as soon as this temporary function is fulfilled are unnecessary to the general economy of the organism and are disposed of without affecting the more permanent vital functions. The major involution, senescence, affects all of the vital organs and functions, not for any purpose of further growth and evolution, but for the purpose of getting rid of the organism itself as

<sup>1</sup>OLD AGE: THE MAJOR INVOLUTION: the Physiology and Pathology of the Aging Process. By Alfred Scott Warthin. Ph.D. M.D. LL.D. New York: Paul B. Hoeber Inc. 1920.

deserve special notice. Walton's chapter on the pituitary body is an admirable condensation of our confused knowledge of this difficult subject. Not only the clinical syndromes but the physiology of the gland is made to appear remarkably easy to master. The section on rectal diseases by Lockhart Mummery is also unusually good. On the whole, the newer methods of diagnosis such as gall bladder visualization and ventriculography are well evaluated.

In a work of such magnitude a few errors are bound to creep in, such as the statement on page 870 that a closed loop of colon causes more toxæmia than one in the small gut. Also, the omission of the features of alkalosis in intestinal obstruction is surprising. Again, the entire matter of visceroptosis to which a full chapter is given would be flatly denied in 1910 by most surgeons today.

Aside from these points and the fact that the illustrations are for the most part very bad one cannot help but feel that this is a valuable addition to surgical literature as it fills a real need and brings the subject of surgical diagnosis up to date.

EDMUND ANDREWS

THE present volume of the *Gynecological and Obstetrical Monographs* represents the first supplement since the completion of the series in 1925. There has been nothing outstanding in the literature in the last 4 or 5 years. Progress however has been made along certain lines as for example in prenatal care while eclampsia and its treatment are still serious problems.

Sterility, according to Child still ranks high as a social problem and not only requires the treatment of wife and husband but the application of biological studies as well.

The chapter on menstruation and its disorders has been ably supplemented by Novak. The author has changed his views somewhat since the publication of his original edition especially as regards the casting off of the menstrual decidua as shown by careful histological preparations of human decidua at various stages during the cycle.

Rubin in his chapter on transuterine insufflation, pleads for more accurate and clear-cut indications and great care in technique. He regards the procedure as safe in good hands.

The diagnosis of early pregnancy is still a problem. The Abderhalden test has been completely discarded. Other metabolic tests based on urinary excretion of glucose after administration of phlorizin have been tried but as yet these tests are not pathognomonic of early pregnancy. The value of X-ray as a diagnostic aid is increasing after recognizability of the fetus (at about 4 months) and may be used until term.

The treatment of eclampsia is still an enigma. The Stroganoff treatment or extreme conservatism is still being employed by some while others are using

caesarean section or other surgical procedures. The Lazard intravenous magnesium sulphate treatment has its advocates and has given fairly satisfactory results in the conservative management of eclampsia.

Ehrenfest has revised his original monograph on birth injuries and has added an excellent bibliography. He emphasizes the immediate recognition of symptoms and lesions which may have a direct bearing on early treatment. Interest in birth lesions has extended beyond the domain of the obstetrician and pediatrician. The pathologist, neurologist, surgeon, laryngologist and ophthalmologist all have taken interest in the subject. Many well known pathological conditions and clinical entities previously designated as congenital are now definitely known to be intra-natal injuries. Surgery has proved very promising in many cases.

Cæsarean section seems to be on the increase and this state of affairs is deplored by many writers. The classical operation has had little added to it in the last 7 years. Newell recommends the low incision and A. B. Davis the high incision in classical cæsarean section. The low cervical operation is gradually increasing in popularity and likewise the indications for it. Its advantages, in doubtful or infected cases, are now definitely admitted. With improved technique and local anesthesia in the hands of a good operator the operation is admitted to be far superior to the classical section. In the group of infected cases the Porro operation is still employed and more recently within the last 2 or 3 years the Torges operation seems to be quite promising. The chapter on cæsarean section is well illustrated.

Many problems in pelvic inflammatory disease are still unsolved. Protein therapy and diathermy in properly selected cases seem to be of value.

Little advance has been made in puerperal sepsis, serum is of no avail surgery is questionable. The best active treatment should consist of removal of sutures and drainage of abscesses.

Plas are made for early recognition of malignant tumors of the uterus. Carcinoma campaigns and propaganda have helped in having patients report early. Radium plus surgery are still the greatest hope. The lead treatment of cancer (Blair Bell) plus X-ray if necessary seem to produce some good results. This treatment is still in the experimental stage. Neither one or all methods are entirely satisfactory to date.

Sampson's theory of endometriosis while still highly interesting has not yet been finally accepted. Culbertson in his chapter on surgery of the female pelvis gives an excellent and clear cut outline of postoperative management. The treatment of peritonitis hæmorrhagica, and shock is systematically organized.

E. L. CORNELL

NOT merely a theoretical contribution to the improvement of museums in general and medical museums in particular, but a description of practical



a whole This can mean but one thing the individual human machine has fulfilled its function, and now useless stands in the way of the progressive evolution of the species In other words the minor involutions take place for the good of the single individual the major involution for the good of the species Inasmuch as the reproductive function is the chief one of the individual life and from the biologic point of view the one logical reason for the ascent and maturity of the animal energy machine it is but logical to conclude that when the carrier of the immortal germ plasma has arrived at maturity and continued at the stage sufficiently long to have secured its survival in his progeny, he, himself is then in the way of evolution Biologically useless he has become and he disappears from the scene by the gradual fading away process of senescence

This volume as a whole possesses real literary merit Parts of it may be too technical for the layman to understand fully Its value for the general public may be questioned because few men possess the intellectual and moral stamina to read it without becoming greatly depressed However, for certain types of minds it will prove helpful because with all its pessimism, in the commonly accepted sense of that term it does show the only way to meet the inevitable with equanimity J P S

IN a small and practical volume on the diagnosis and treatment of gastric and intestinal diseases Cheney emphasizes the clinical rather than the laboratory means of diagnosis For instance the point of view in regard to the X ray diagnosis of these conditions is conservative a point of view much needed now when there is a tendency to believe anything read into the X ray films Thus By X ray examination theoretically it is easy to distinguish the presence of pathology in this organ (the gall bladder) As a matter of fact, however the expected X ray evidence is not always definite enough one way or the other to make the diagnosis certain and it becomes of value only when considered in connection with other facts These other facts as emphasized throughout the work are the symptoms elicited by intelligent history taking The description of these syndromes is excellent

The author's point of view as regards surgery is well represented by one of his rules in regard to intestinal obstruction i.e. call a surgeon in consultation early so that he may share in the responsibility for the decision as to when medical efforts shall cease and surgical shall be employed and so that if the ultimate outcome is unfavorable the charge can not be made that the surgeon was called too late The problem of diagnosis is always presented from both sides i.e. the negative or dubious as well as the positive or certain This treatise therefore becomes helpful where help is most needed that is in

the obscure abdominal conditions The character of the book is well presented in the following sentence 'Face to face with the problem at the bedside familiar with all the theoretical points that should distinguish one condition from the other the physician finds occasionally that the conclusion reached is erroneous as is shown ultimately by operation or by autopsy Every effort should be made by every method of examination to reach an accurate deduction as to which form of disease is present, but a spirit of humility is much more fitting than one of pride in this uncertain field of diagnosis'

PAUL STARR

THE book entitled *The Mobilization of Ankylosed Joints by Arthroplasty* is an interesting and readable monograph The technique of the authors differs in many particulars from that of other operators especially in the character of the incisions recommended and in the careful preservation of the capsule surrounding the joint Murphy and many others advise the removal of the thickened and usually adherent capsule

The use of a double layer of free fascial flap is a valuable suggestion, and the method of attaching it is ingenious In the chapter on arthroplasty of the hip, the diagram shows the fascial flap fastened with a purse ring around the large and well modeled head of the femur while the X ray pictures with one exception show that the head has been entirely removed so as to leave only a conical stump of the neck around which no pursestrapping ligature could possibly hold It is however a fact that nearly all of the illustrations of hip arthroplasties so far published show the same wide removal of the head and since most of these cases were of satisfactory results it is probable that the bold resection of the head is productive of greater mobility and scarcely less stability than is provided by a more perfect anatomic modeling

Concerning arthroplasty of the knee the authors propose the use of a straight anterior incision in the skin with an inverted X incision through the quadriceps tendon and the joint coverings It is doubtless as good as any of those used by other operators and has the merit of simplicity The illustrations of Putti's technique are apparently reproduced from one of his earlier articles and differ from his present method in many important particulars

The descriptions of the authors' operations are not sufficiently clear to enable an inexperienced surgeon to follow them with ease and certainty The illustrations both diagrammatic pictures and X ray reproductions have not been well chosen and do not depict adequately the excellent technique and the great experience of the authors

The bibliography shows careful and extensive research EDWIN W. RYERSON

JOINTS MONOGRAPHS ON DIAGNOSIS AND TREATMENT Edited by Henry A. Christian M.D. Sc.D. LL.D. Vol. II THE DIAGNOSIS AND TREATMENT OF DISEASES OF THE STOMACH AND INTESTINES By William Fitch Cheney B.L. M.D. New York Oxford University Press 1926.

THE MOBILIZATION OF ANKYLOSED JOINTS BY ARTHROPLASTY BY W. R. and MacCallister, M.D. and Andrew R. MacCallister, M.D. Philadelphia Lea & Febiger 1926

THE late Sir John O'Connor was for many years Senior Medical Officer of the British Hospital at Buenos Aires. In the present volume on *Reflections and Operations*<sup>1</sup> are collected O'Connor's many contributions to the surgical literature representing observations and conclusions based on forty years of active surgical practice. The originality and forcefulness of this volume will bring pleasure, interest and stimulation to every surgeon. O'Connor refers to the statement that a good surgeon is not necessarily a good technician as 'claptrap' and 'academic blather' and substantiates his right to criticize by listing 1,200 operations all of which were done in 12 minutes or less. The practical nature of the author's comments is evidenced by the following:

It seems somewhat of a farce to set papers for examination containing questions—for example the dissection and difficulties attending exposure of the pituitary gland, carotid body or semilunar ganglion—to candidates who do not know how to hold a knife or handle a needle and if entrusted with the application of a ligature to a pedicle even money make such a violent tug on the second ligament as to smash up the whole procedure. Despite the great amount of sound common sense in the volume it is scarcely to be recommended for students. O'Connor places great stress on the value of alcohol in health and disease and even makes the statements that 'Teetotalism is a frequent cause of arteriosclerosis' and 'universal total abstinence would tend in a comparatively short cycle of time to depopulate the earth'. His recommendation of a pint of champagne by rectum in the treatment of shock would be a very expensive treatment in this country. Almost the entire field of surgery is covered with the eyes of an experienced worker and active observer.

FREDERICK CHRISTOPHER

IN a volume on *Surgical Diagnosis*<sup>2</sup> Donhauser has essayed the task of covering the entire field of surgical diagnosis. He begins with history taking. Chapters on general surgery, dealing with infections, tumors and kindred subjects follow. The remainder of the text is devoted to regional diagnosis, urology and gynecology included.

The text is written in the form commonly used in teaching undergraduate students and is clear and concise. Its brevity however necessarily limits its use to that of a reference volume for junior and senior students.

J. R. BLICHNER

IN no place except in a clinic such as found in Vienna where a tremendous mass of material is gathered together for careful and thorough study could a work such as Lenk's book on *Röntgen*

*diagnostik* be done. The author has collected a tremendous array of lung tumors and subjected these cases to thorough and exhaustive study. As a result every known tumor of the lung is carefully described. The book is profusely illustrated with X-ray pictures and these pictures are analyzed and discussed in great detail. Wherever necessary, diagrammatic reproductions of the pictures are used to clarify further the author's analysis thereof. Not only are cases of intrathoracic tumor described and this the reviewer feels is of tremendous importance but cases are presented whose X-ray pictures simulate those of lung tumors and in these cases the differential diagnosis is carefully discussed. The reviewer knows of no other work in which the roentgen diagnosis of intrathoracic tumors is discussed in such an efficient and thorough manner. The excellent index is of great assistance in facilitating the study of Lenk's book. The book, although written in German ought to be of tremendous interest to every physician who is called to deal with lung tumors and will undoubtedly be a standard reference on the shelf of every roentgenologist.

RALPH B. BETTMAN

THE book entitled *Die Pathogenetischen Grundlagen der Thyreotoxikotherapie*<sup>3</sup> is a relatively brief monograph dealing with certain clinical aspects of thyrotoxicosis namely classification, preoperative preparation and operative technique. For the most part, there is no serious criticism of the author's ideas on thyrotoxicosis although some exception may be taken to the withholding of iodine as a preoperative measure in adenomas or as he calls them secondarily toxic thyroids.

It is interesting to note that during the past 5 years in the services of a general hospital and the surgical division of a University clinic the author has operated upon but 150 thyroids.

The text is not illustrated save for a few schematic drawings and several plates representing histopathologic findings.

J. R. BLICHNER

LOVE'S *Shorter Surgery*<sup>4</sup> is well named in less than 300 pages the author skips lightly over the entire field of surgery. The book is intended for the use of students in conjunction with a surgical text. It is written in the so-called outline form and is somewhat more voluminous than the usual quiz compend.

J. R. BLICHNER

TO all interested in thyroid disease Hertzler's book<sup>5</sup> should be of great value since it represents the results of prolonged clinical study. It is by no means a review monograph covering the literature of the subject. It reports the author's own studies

<sup>1</sup> REFLECTIONS AND OPERATIONS. By Sir John O'Connor, K.B.E. M.A., M.D. (Dub. Univ.). With a Foreword by Herbert J.P. C.B.E., M.C., M.D. (Camb.) F.R.C.S. (Eng.) London: Baillière Tindall (1921) 10s. 6d.

<sup>2</sup> A SURGICAL DIAGNOSIS. By J. Lewis Donhauser, A.B., M.D., F.A.C.S. New York and London: D. Appleton and Company, 1920.

<sup>3</sup> DIE RÖNTGENDIAGNOSTIK DER INTRATHORAKALEN TUMOREN UND IHRE DIFFERENTIALDIAGNOSE. By Dr. Robert Lenk, V.n. J. 18. Sp. 1920.

<sup>4</sup> DIE PATHOGENETISCHEN GRUNDLAGEN DER THYREOTOXIKOTHERAPIE. By Jobst Holst, O.J. Jacob Dybbø 1925.

<sup>5</sup> A SHORTER SURGERY: A PRACTICE MANUAL for Senior Students. By R. J. McNeill Love. New York: W. B. Saunders Company, 1920.

DISEASES OF THE THYROID GLAND. By Arthur E. Hertzler, M.D. With a Chapter on Hyperthyroidism. By Arthur E. Hertzler, M.D. With a Chapter on Myxoedema. By Arthur E. Hertzler, M.D. E. Chevalier, M.D. St. Louis: The C. V. Mosby Company, 1920.



and experience and does this in a most refreshing way

Typical quotations are as follows "I have always liked the term polyglandular disturbances. It says nothing tangible and stops further discussion. A soft palpable thyroid is normal in a thin necked child. Too many operators attack every thyroid they can feel. This is incorrect in patients of any age. Too many itchy fingers seek an excuse to operate rather than a reason for doing so.

As the author says in his preface to this second edition 'The chief interest I hope will center on the views of the pathology of the thyroid herein set forth'. These views are stated comprehensively and occupy over a third of the total work and are accom-

panied by many illustrations including macrophotographs. Perhaps his most characteristic idea is that contained in this statement in regard to the ordinary classification of goiters into colloid adenomatous and exophthalmic. In following such a classification one must remember that these classes do not represent separate diseases but merely stages at least for the most part of one progressive disease. I have many times seen the same individual run the gamut of the whole series: simple colloid non toxic adenoma, toxic adenoma, developing finally into a typical Basedow triad and finally death by heart failure.

I feel sure this work is worthy of careful study and contains much truth.  
PAUL STARR

## BOOKS RECEIVED

Books received are acknowledged in this department and such acknowledgment must be regarded as a sufficient return for the courtesy of the sender. Selections will be made for review in the interests of our readers and as space permits.

**LA AUTONOMÍA DEL CORAZÓN. CONFERENCIAS PRONUNCIADAS EN EL INSTITUTO DE FISIOLÓGICA DE LA UNIVERSIDAD DE CONCEPCIÓN.** By Prof. Dr. Alejandro Lipschütz. Santiago. Revista Atenas 1929.

**BIOLOGÍA Y PATOLOGÍA DE LA MUJER.** By Josef Halban and Ludwig Seitz. Translated directly from the original German by Joaquín Núñez Grimaldos with the collaboration of Dr. D. Arcadio Sánchez López. Vol. 1. Madrid. Editorial Ilus Ultra 1929.

**THE COMMON HEAD COLD AND ITS COMPLICATIONS.** By Walter A. Wells. M.D. F.A.C.S. With introduction by Hugh S. Cumming. M.D. New York. The Macmillan Company 1929.

**DIE EKLAEMPIE UND IHRE PROPHYLAXE.** By Edmund Hermann. Berlin. Vienna. Urban & Schwarzenberg 1929.

**OUTLINE OF PREVENTIVE MEDICINE FOR MEDICAL PRACTITIONERS AND STUDENTS.** By various authors. New York. Paul B. Hoeber Inc. 1929.

**STONE IN THE URINARY TRACT.** By H. P. Winsbury. White. M.B. (Edin.) F.R.C.S. (Edin.) F.R.C.S. (Eng.) Philadelphia. P. Blakiston's Son & Co. 1929.

**SURGICAL AND MEDICAL GYNECOLOGIC TECHNIC.** By Thomas H. Cherry. M.D. F.A.C.S. Philadelphia. F. A. Davis Company 1929.

**THE MIND AT MISCHIEF. TRICKS AND DECEPTIONS OF THE SUBCONSCIOUS AND HOW TO COPE WITH THEM.** By William S. Sadler. M.D. F.A.C.S. Introduction by Robert H. Gault. I.B.D. and Meyer Solomon. M.D. New York and London. Funk & Wagnalls Company 1929.

**STERILIZATION FOR HUMAN BETTERMENT. A SUMMARY OF RESULTS OF 6,000 OPERATIONS IN CALIFORNIA, 1909-1929.** By T. S. Gosney. B.S. LL.B. and Paul Popenoe. D.Sc. New York. The Macmillan Company 1929.

**TREATMENT BY MANIPULATION. A PRACTICAL HANDBOOK FOR THE PRACTITIONER AND STUDENT.** By A. G. Timbrell Fisher. M.C. F.R.C.S. (Eng.) 2d ed. New York. The Macmillan Company 1929.

**TEXTBOOK OF SURGICAL NURSING.** By Ralph Colp. A.B. M.D. F.A.C.S. and Van Iva Wylie Keller. B.S. R.N. 2d ed. rev. New York. The Macmillan Company 1929.

**A GRAPHIC GUIDE TO ELEMENTARY SURGERY.** By Prof. Dr. Th. Naegeli. Translated by J. Snowman. M.D. M.R.C.P. Introduction by Dr. C. Garré. New York. William Wood and Company 1929.

**MINOR SURGERY.** By Frederick Christopher. M.D. F.A.C.S. Foreword by Allen B. Kanavel. M.D. F.A.C.S. Philadelphia and London. W. B. Saunders Company 1929.

**AN INTRODUCTION TO PHARMACOLOGY AND THERAPEUTICS.** By J. A. Gunn. M.D. D.Sc. (Edin.) M.A. (Oxon.) New York and London. Humphrey Milford. Oxford University Press 1929.

**THE PRINCIPLES OF CLINICAL PATHOLOGY IN PRACTICE. A GUIDE TO THE INTERPRETATION OF LABORATORY INVESTIGATION FOR THE USE OF THOSE ENGAGED IN THE PRACTICE OF MEDICINE.** By Geoffrey Bourne. M.D. (Lond.) M.R.C.P. and Kenneth Stone. M.D. (Oxon.) M.R.C.P. New York and London. Humphrey Milford. Oxford University Press 1929.

**INTERNATIONAL CLINICS. A QUARTERLY OF ILLUSTRATED CLINICAL LECTURES AND ESPECIALLY PREPARED ORIGINAL ARTICLES ON TREATMENT, MEDICINE, SURGERY, ETC.** Edited by Henry W. Castle. A.M. M.D. with the collaboration of others. Vol. 11. 30th series 1929. Philadelphia and London. J. B. Lippincott Company 1929.

**THE AFTER TREATMENT OF OPERATIONS. A MANUAL FOR PRACTITIONERS AND HOUSE SURGEONS.** By P. Lockhart Munnery. F.A.C.S. (En.) M.A. M.B. B.C. (Cantab.) 5th ed. New York. William Wood and Company 1929.

**DISEASES OF THE STOMACH. A TEXTBOOK FOR PRACTITIONERS AND STUDENTS.** By Max Kunkov. M.D. (4th rev. ed.) New York. William Wood and Company 1929.

**INTERNAL HANDBOOK. A GUIDE TO RATIONAL DRUG THERAPY. CLINICAL PROCEDURES AND DIETS.** By Members of the Faculty of the College of Medicine, Syracuse University under the Direction of M. S. Dooley. A.B. M.D. Chairman Publication Committee. Philadelphia and London. J. B. Lippincott Company 1929.

# SURGERY, GYNECOLOGY AND OBSTETRICS

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## A STUDY OF THE FASCIAL SPACES OF THE FOOT AND THEIR BEARING ON INFECTIONS

MANUEL GRODINSKY M.D. OMAHA, NEBRASKA  
Department of Anatomy College of Medicine University of Nebraska

THE memorable work of Kanavel on the fascial spaces and tendon sheaths of the hand has given great impetus to a more thorough study of infections of the hand and with it better results from treatment properly applied. For some reason, no similar study has been made of the foot. Possibly this is due to the fact that foot infections are less common than hand infections because of the protection afforded by the wearing of shoes. Again it may be due to the fact that the clinical problem presented differs somewhat in the two cases. In that of the hand, there is, in addition to the immediate danger to life and the length of convalescence, an important economic problem concerned with the preservation of function. The hand is a very delicately balanced mechanism capable of carrying out the most intricate and skillful of movements—so important economically.

The foot is not so delicately adjusted nor is it of such direct importance in economic life. The foot is chiefly concerned with body support and locomotion, functions which, though they are important enough, are more easily preserved following infections than those of the hand. It makes little difference if the flexor tendon to one of the toes is functionless, but a similar condition in the hand would be of utmost importance. However, it is just as essential to get the patient with an infected foot well and back to work

at the earliest possible moment as it is the one with an infected hand, so that from the standpoint of length of convalescence, as well as immediate danger to life, the foot becomes just as important as the hand.

This study was undertaken with the feeling that a better knowledge of the anatomy of the foot, particularly of the fascial spaces, might lead to a better understanding of foot infections, with lessened immediate mortality, shortened convalescence, and possibly better preservation of function as regards body support and movement. Two methods of study were used: first, careful dissection of the human foot to determine the extent and boundaries of the various fascial spaces; second, injection of the spaces with gelatin or paraffin to outline them and determine the route of spread from one to the other.

### DISSECTIONS

Careful dissection of fresh and preserved human material reveals the presence of four potential median spaces on the plantar side of the foot, which may be conveniently designated as M<sub>1</sub>, M<sub>2</sub>, M<sub>3</sub>, and M<sub>4</sub>. In addition, a lateral space deep to the abductor digiti quinti, a medial space deep to the abductor hallucis, and spaces along the lumbrical muscles may be demonstrated. There are also two dorsal spaces—subcutaneous and subaponeurotic. Again, there is a space

between the superficial and deep calf muscles which is brought into relation with the foot by the long flexor tendons behind the medial malleolus, and a space deep to the fascial sheaths of the peronei, the tendons of which extend behind the lateral malleolus toward the foot. The extent and boundaries of these spaces may be seen in Figures 1 to 4 which are drawings of actual dissections the first being a superficial view and each succeeding one at a deeper plane but drawn in the same proportions. The relations between these spaces can be further studied by referring to the drawings of the sagittal and cross sections (Figs 5 to 7).

The removal of the skin and superficial fascia exposes the plantar aponeurosis in which a thick, middle portion over the flexor digitorum brevis, a thinner portion over the abductor digiti quinti (calcaneometatarsal band), and a very thin, indistinct portion over the abductor hallucis muscle can be distinguished. The middle portion consists of transverse and longitudinal fibers, the latter lying more superficially. Opposite the middle of the metatarsal bones, it divides into five slips extending to the bases of the toes. These slips are joined by ill defined transverse fibers or superficial transverse metatarsal ligaments which help to support the webs of the toes. Each slip splits into two divisions which are attached to either side of the metatarsophalangeal articulation and the base of the first phalanx. In addition some of the longitudinal fibers extend into the skin of the toes and more particularly into the superficial layer of the digital fascia as described below.

#### MEDIAN PLANTAR SPACE M1

M1 lies between the central part of the aponeurosis superficially and the flexor digitorum brevis muscle deeply (Figs 1, 5, 6, 7). The lateral and medial boundaries of this space are connective tissue downgrowths from the plantar aponeurosis which are continuous with the corresponding boundaries of M2 described below. This space is incompletely subdivided into four anteroposterior compartments by three very thin connective tissue septa which are reflections of the fascia

on the deep side of the aponeurosis and the superficial side of the flexor digitorum brevis muscle. A compartment lies proximal to each subcutaneous space between the slips of the plantar aponeurosis. Each is partially subdivided by incomplete transverse septa particularly at the level of the base of the fifth metatarsal bone where the first and fourth end proximally. The second is the longest and extends posteriorly to within 2 to 3 centimeters of the medial tubercle of the calcaneus. The third is the shortest and runs into the second 2.5 centimeters distal to the base of the fifth metatarsal bone. All four communicate more or less freely, and the septa may be easily broken down. Posterior to these compartments, the aponeurosis and flexor brevis muscle are very closely united and require sharp dissection to separate them. Anteriorly, the compartments end opposite or proximal to the middle of the metatarsal bones where the fascia of the floor and roof come together. This wall may be easily broken through into the subcutaneous interspaces, especially along the digital nerves which are themselves covered by sheaths derived from the fascia of the floor of M1.

#### MEDIAN PLANTAR SPACE M2

By detaching the plantar aponeurosis and flexor brevis muscle from the calcaneus and turning the resulting flap forward, a second median plantar space, triangular in shape is uncovered lying between the flexor brevis and the quadratus plantæ muscles, the latter being joined medially by the flexor digitorum longus tendon (Figs 2, 5, 7). This space is lined with fascia which consists of the sheaths of the flexor brevis and quadratus plantæ muscles and their reflections at the periphery. The apex lies 1 centimeter anteromedial to the medial tubercle of the calcaneus, on or slightly above a line between that point and the tuberosity of the navicular bone. Between the quadratus plantæ and its fascial sheath, the lateral plantar nerve and vessels extend in an anterolateral direction, the artery with its two vena comites lying posterolateral to the nerve.

The lateral boundary of M2 which is likewise the boundary of M1 and M3, is a

connective tissue septum continuous superficially with the plantar aponeurosis and extending from the medial tubercle and medial side of the calcaneus to the medial side of the head of the fifth metatarsal bone. The posterior extremity of this septum is fused with the sheath of the abductor digiti quinti and in this region the lateral space deep to that muscle and the median space M<sub>2</sub> are separated only by the double septum resulting from this fusion. In the posterior half of the foot the septum is attached deeply to the tarsal bones and ligaments, and is directed medially as well as posteriorly and deeply as it approaches the calcaneus, so that a portion of the lateral space intervenes between M<sub>2</sub> and the calcaneus. Anteriorly, it attaches on its deep side to the inferomedial border of the third plantar interosseous and splitting to inclose this muscle, finally gains attachment to the medial border of the fifth metatarsal bone and to the proximal phalanx at the insertion of the muscle. This portion is, therefore, directed deeply and laterally.

Anteriorly, the lateral boundary of M<sub>2</sub> and the sheath of the abductor digiti quinti are separated by the lateral plantar structures and the flexor digiti quinti brevis muscle. As the lateral plantar artery crosses the posterior extremity of M<sub>2</sub>, deep to the fascia covering the quadratus plantæ muscle, it gives off a branch which perforates or passes under the common septum between that and the lateral space. The main trunk passes through the lateral boundary of M<sub>2</sub> about half way between the medial tubercle of the calcaneus and the base of the fifth metatarsal bone, and extends forward between that septum and the sheath of the abductor digiti quinti, soon giving off an additional branch to the lateral space. About 2.5 centimeters distal to the base of the fifth metatarsal bone, it passes deep on the medial side of the flexor digiti quinti brevis and again piercing the lateral boundary of M<sub>2</sub> and M<sub>3</sub> enters the latter space by crossing the metatarsal bones and interosseous muscles. At the lateral border of the adductor hallucis obliquus, it runs deep to that muscle and forms the plantar arch giving off the four plantar metatarsal arteries. Before going deep, it sends a metatarsal

branch to the lateral side of the little toe. Two vena comites accompany the artery and its branches.

The lateral plantar nerve crosses M<sub>2</sub>, pierces its lateral wall just distal to the vessels, and, opposite the base of the fifth metatarsal bone, divides into superficial and deep branches, the latter of which accompanies the vessels into the depths of the foot. The superficial branch almost immediately subdivides into a digital nerve to the lateral side of the fifth toe and a nerve which winds around the lateral border of the flexor digitorum brevis into M<sub>1</sub> and extends forward to supply the adjacent sides of the fourth and fifth toes.

The medial boundary, which is likewise the boundary of M<sub>1</sub>, M<sub>3</sub>, and M<sub>4</sub>, is a fibrous tissue septum continuous superficially with the plantar aponeurosis and including in its posterior part some of the muscle fibers of the flexor digitorum brevis as the latter bends around medially to gain attachment to the calcaneus. It extends anteromedially from the medial side of the calcaneus to the lateral side of the head of the first metatarsal bone. On its deep side it becomes attached posteriorly to the tarsal bones and ligaments, and anteriorly to the lateral side of the first metatarsal bone, after passing between the adductor hallucis obliquus and the flexor hallucis brevis and helping to form the sheaths of both muscles. Superficially, its anterior extremity is fused with the insertion of the lateral head of the flexor hallucis brevis and with the fibrous sheath of the flexor hallucis longus, thus gaining attachment to the phalanges of the big toe. Opposite the base of the fifth metatarsal bone the tendon of the flexor digitorum longus crosses over that of the flexor hallucis longus and pierces the medial wall of M<sub>2</sub> and M<sub>3</sub> to join the quadratus plantæ muscle but, as it does so, the margins of the wall are closely adherent to it, thus completing the separation of the median foot spaces from the space passing behind the medial malleolus into the leg. However, the separating septum is very thin here and easily broken down, as will be shown in the injection experiments.

Posterior to the base of the fifth metatarsal bone the medial wall is fused with the sheath

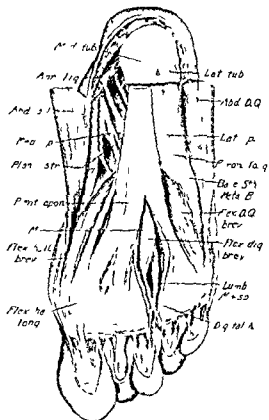


Fig 1 Superficial plantar view of human foot showing plantar aponeurosis and related structures

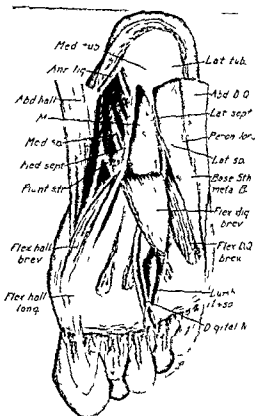


Fig 2 Same as in Figure 1 but plantar aponeurosis and flexor digitorum brevis muscle reflected anteriorly

of the abductor hallucis thus forming a common septum between the medial space deep to that muscle, and M2 in this part of the foot. In the middle of the foot the medial wall of M2 and the sheath of the abductor hallucis are separated by the crossing of the long flexor tendons. More anteriorly they are separated by the flexor hallucis longus tendon and the flexor hallucis brevis muscle.

The medial plantar nerve, lying in the medial wall of M2, divides 2 to 3 centimeters anterior to the calcaneus. The medial branch continues forward (medial to M2) and becomes the digital branch to the inner side of the big toe. The lateral branch soon bulges into M2 (though still separated from that space by a layer of fascia), and finally passes around the flexor brevis to enter M1. It then divides into three common digital branches

which pass forward superficially to the three medial lumbrical muscles and divide into proper digital branches for the adjacent sides of the corresponding toes. The medial plantar artery (and veins) divides into branches which in general follow the same course as those of the nerve, the medial branch being distributed to the inner side of the big toe and the lateral branch passing into M1 and supplying three common digital branches which anastomose distally with the plantar metatarsal arteries from the deep arch.

Anteriorly, M2 extends as a distinct space only to a line opposite the base of the fifth metatarsal bone where the fascia of the roof and floor are joined by loose areolar tissue. This may be easily broken through and the space extended forward into the interspaces between the slips of the plantar aponeurosis,

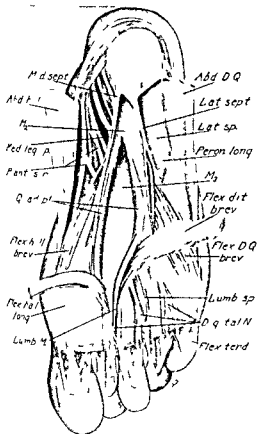


Fig. 3 Same as in Figure 2 but quadratus plantæ muscle incised and spread laterally

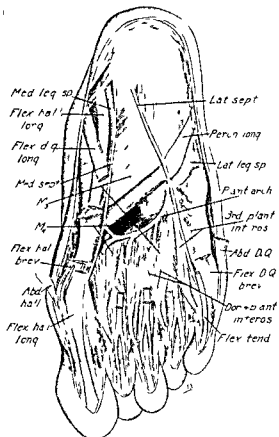


Fig. 4 Same as in Figure 3 but all plantar muscles except the interossei removed

where it enters superficially to the sheaths of the lumbrical muscles and between them and the overlying fascia (Fig. 7). In breaking through this areolar tissue, it is noted that anteriorly somewhat stronger connective tissue fibers divide this part of  $M_2$  into four ill defined compartments, each in line with a lumbrical groove. The walls of these compartments are part of the paratendinous sheaths described later.

#### MEDIAN PLANTAR SPACE $M_3$

If the quadratus plantæ muscle and its sheath be detached from its origin on the calcaneus and from the tendon of the flexor digitorum longus and turned forward, still another median plantar space ( $M_3$ ) is found deep to it (Figs. 3, 4, 5, 7). This space is also triangular in shape, with the apex lying 2 to

3 centimeters anterior to that of  $M_2$ . The floor of the space consists of the tarsal bones and ligaments and, more anteriorly, the tendon of the peroneus longus, the adductor hallucis obliquus, and the plantar and dorsal interossei muscles—all covered by fascia. The medial boundary of  $M_3$  is continuous with that of  $M_1$ ,  $M_2$ , and  $M_4$ . Due to the concavity of the main arch of the foot, the lateral boundary of  $M_3$  consists chiefly of the tarsal bones and ligaments (especially the long plantar ligament) posteriorly, and the third plantar and fourth dorsal interossei muscles anteriorly. Since the fibrous tissue lateral boundary of  $M_1$  and  $M_2$  joins the tarsal bones and ligaments posteriorly and the margin of the third plantar interosseous muscle anteriorly, it likewise comes into relation with  $M_3$  superficially. Because of the



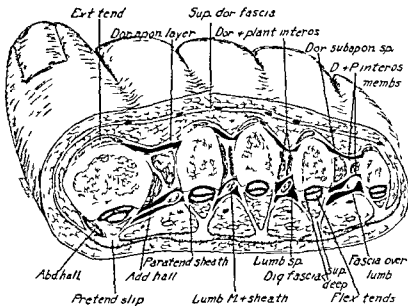


Fig 6 Cross section just proximal to the metatarsophalangeal joints (distal surface)

the sheath of the adductor obliquus muscle, is on a line with the lateral side of the first metatarsal bone and is continuous with the medial boundary of  $M_1$ ,  $M_2$ , and  $M_3$ . The lateral boundary is the sheath of the muscle and is on a line between the base of the fourth metatarsal bone and the lateral side of the base of the first phalanx of the big toe.

The plantar arch of blood vessels lies for the most part deep to the adductor obliquus muscle, and the plantar metatarsal vessels take origin there ( $M_4$ ). The deep branch of the lateral plantar nerve follows the arch across this space.

#### LUMBRICAL AND SUBCUTANEOUS INTERSPACES

The interspaces between the slips of the plantar aponeurosis are occupied by subcutaneous fatty tissue (superficial fascia) in the substance of which run the common digital nerves, surrounded by their sheaths derived from the fascial floor of  $M_1$ , and distally also the plantar metatarsal vessels which become superficial near the necks of the metatarsal bones (Figs 1 to 7). If the nerve and vessel be dissected out and the fatty tissue removed, a definite and fairly firm layer of fascia is seen overlying each lumbrical muscle and extending between the

lateral walls of the lumbrical groove. Proximally, the subcutaneous interspaces superficial to this fascia are separated from  $M_1$  by transverse connective tissue septa about 3 to 4 centimeters proximal to the heads of the metatarsal bones. These septa are easily broken through, particularly along the digital nerves which pass from  $M_1$  into the subcutaneous interspaces. Cutting through the fascia overlying the lumbrical muscles exposes the latter, each enclosed in a thin fascial sheath derived from that of the flexor digitorum longus and quadratus plantae muscles from which it takes origin on a line between the middle of the fifth and the head of the first metatarsal bones. This sheath is attached to the lateral wall on either side of the groove. At their origins, the lumbrical muscles are in relation with the short flexor slips which cross them superficially and the deep flexors which are lateral to them. Anteriorly, both tendons lie lateral to the lumbrical grooves and are separated from them by their fascial coverings derived from the muscles from which they originate. These coverings correspond to the paratendinous sheaths of the hand described by Kanavel and his associates and are reinforced by deep bands from the plantar



aponeurosis to form the lateral walls of the lumbrical tunnels. Anteriorly, these walls gain attachment to the capsules of the metatarsophalangeal joints, to the transverse metatarsal ligaments, and to the deep layer of the digital sheaths.

The potential space between each of the lumbricals and the overlying fascia is separated from the distal end of M<sub>2</sub> by loose areolar tissue which is easily broken through putting these spaces into communication. Distally, at its insertion into the extensor tendons, each lumbrical extends into the dorsal subcutaneous region. Deep to each lumbrical muscle and its sheath, lies the loose areolar tissue in the corresponding anterior compartment of M<sub>3</sub>. This tissue is also easily broken through, thus placing the lumbrical groove into communication with M<sub>3</sub>.

#### DIGITAL SHEATHS

There is a common synovial sheath for the long and short tendons to each of the lateral four toes and one for the long tendon to the big toe. These extend from the insertions of the tendons distally to or beyond the necks of the metatarsal bones proximally. Each synovial sheath is surrounded by a dense fibrous covering, the deep layer of the digital sheath, which binds the tendons to the sides of the phalanges and ends opposite the head of the metatarsal bone or rather becomes much thinner there and continues proximally, over the tendons and deep to the aponeurosis, to merge with the fascia over the flexor digitorum brevis (Figs 5, 6). Laterally, this layer continues around the tendons as the paratendinous sheath and, together with the reinforcing bands from the plantar aponeurosis, forms the lateral wall of the lumbrical groove. Overlying the deep digital sheath is another, less dense layer containing the digital nerves and vessels and receiving proximally part of the digital slip of the plantar aponeurosis. Some of these aponeurotic fibers cross over obliquely from one side of the proximal phalanx to the other, somewhat similar to the condition described in the hand by Kanavel, and help explain the displacements of the digital structures in Dupuytren's contraction.

#### LATERAL PLANTAR SPACE

This is the potential space under the abductor digiti quinti, from its origin to its insertion, and between that muscle and the deep part of its sheath (Figs 1, 2, 3, 5, 6). The superficial portion of the sheath is the thickened lateral band (calcanometatarsal band) of the plantar aponeurosis and the deep portion is the fascia overlying the long plantar ligament, the tendon of the peroneus longus muscle as it enters the foot and, more anteriorly, the flexor digiti quinti brevis muscle. Laterally, the superficial and deep portions of the sheath come together to shut off the lateral plantar space from the lateral leg space along the peronei tendons and muscles.

#### MEDIAL PLANTAR SPACE

This is the potential space deep to the abductor hallucis and between that muscle and its sheath (Figs 1, 2, 5, 6). It extends from the origin of the muscle on the calcaneus to the point where its tendon fuses with the medial head of the flexor hallucis brevis (2.5 centimeters anterior to the base of the fifth metatarsal bone). The fascial sheath deep to this space covers the posterior tibial and plantar structures as well as the long flexor tendons entering the foot behind the medial malleolus and shuts off those structures from this space. The sheath is completed superficially and medially by the thin medial portion of the plantar aponeurosis.

#### DORSAL FOOT SPACES

Two distinct spaces can be recognized, subcutaneous and subaponeurotic (Figs 3, 6, 7). The former is continuous with the subcutaneous regions adjacent and receives the insertions of the lumbrical muscles, just as in the hand. The subaponeurotic space is that lying deep to the deep fascia overlying and enclosing the extensor tendons, and between that fascia and the dorsal interosseous membrane. It is in relation with M<sub>3</sub> and M<sub>4</sub> through the interosseous spaces as described.

#### MEDIAL LEG SPACE

Following superficially and proximally along the tendons of the flexor hallucis longus, flexor digitorum longus, and tibialis

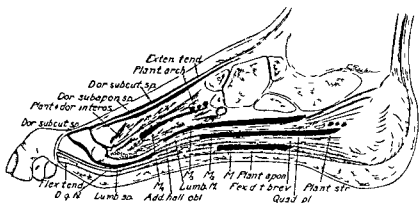


Fig 7 Sagittal section of foot between the second and third toes (lateral surface)

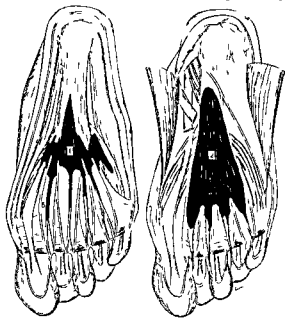
posterior, one comes to a large potential space (Fig 15) between those muscles and the superficial calf muscles (gastrocnemius and soleus). The upper extremity of this space corresponds to the origin of the soleus from the tibia and fibula at the junction of the middle and upper thirds. In it lie the posterior tibial vessels and nerves which extend between the origins of the soleus still farther proximally into the popliteal space. Distally these structures pass under the annular ligament toward the medial wall of  $M_1$  and  $M_3$ , dividing meanwhile into medial and lateral plantar branches.

The long flexor tendons likewise lead under the annular ligament and abductor hallucis muscle (but separated from the medial space by a distinct layer of fascia) to the medial side of  $M_2$ , where the flexor digitorum longus crosses over the flexor hallucis longus and pierces the medial wall to join the quadratus plantae muscle, while the flexor hallucis longus continues forward and superficially toward the big toe. The tibialis posterior, after having been crossed over by the flexor digitorum longus in the lower third of the leg, lies more anteriorly and passes across the tuberosity of the navicular bone anterolaterally toward its insertion. It is seen, therefore, that, although there is no direct connection between the leg and foot spaces, certain structures (tendons, nerves, and vessels) pass from one to the other and make probable the extension of injection material or infection alongside them. However, the tight annular

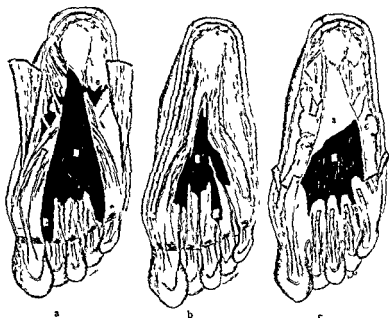
ligament offers strong resistance to passage of material under it proximally or distally.

#### LATERAL LEG SPACE

Within the sheaths of the peroneus longus and brevis, a potential space can be traced proximally to the upper third of the leg (Fig 16). A break through this sheath posteriorly would lead into the large medial leg space between the long flexor and superficial calf muscles. A break anteriorly or superficially



Figs 8a and b Diagrammatic drawing showing spread of injection mass from  $M_1$  &  $M_2$  &  $M_3$  subcutaneous interspace along digital nerve



Figs. 9a, b, and c. Diagrammatic drawing showing spread of injection mass from M<sub>2</sub> 1 M<sub>1</sub> 2 M<sub>2</sub>, 3 M<sub>3</sub> 5 subcutaneous and lumbrical interspaces 6 lateral plantar space 10 medial leg space 11 lateral leg space

would lead to subcutaneous infiltrations. Distally, after passing under the lateral annular ligament the tendon of the peroneus brevis bends sharply anteriorly to its insertion on the base of the fifth metatarsal bone while that of the peroneus longus enters the foot behind and deep to the base of the fifth metatarsal bone and passes anteriorly, medially, and deeply to its insertion on the first cuneiform and first metatarsal bones. In its course under the abductor digiti quinti, the peroneus longus is separated from the lateral plantar space by a definite and heavy layer of fascia as well as by its own fibrous sheath. In the depths of the foot it is separated from M<sub>3</sub> and M<sub>4</sub> by its sheath. The lateral leg space is, therefore, also separated from the foot spaces but again we may anticipate rupture into the foot particularly into the lateral plantar space and the median plantar spaces M<sub>3</sub> and M<sub>4</sub> because of their close relationship to the peroneus longus tendon.

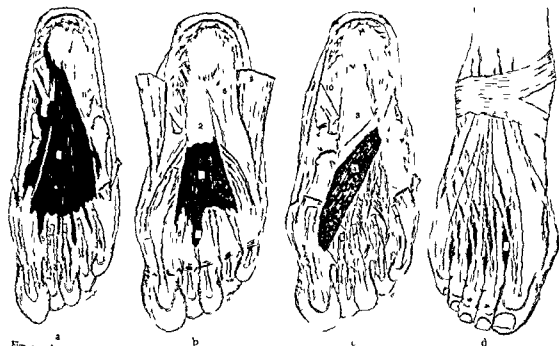
#### INJECTION EXPERIMENTS

In a total of 58 injections, two types of material were used paraffin colored with

Sudan III or spirit blue, and gelatin colored with India ink. The latter was found to be most satisfactory because of the slower setting time and ease of handling. Both fresh and preserved human material were used. A few injections were made under pressure bottle control but most were done with a Luer syringe and needle the pressure being controlled by the volume used. Attempts were made to fill the various spaces found in the dissections. In some cases, these masses were confined to the spaces injected but in others they spread into adjacent spaces.

*Extension from M<sub>1</sub> (Fig. 8).* All the injections into this space showed breaks medially and laterally as well as through the plantar surface of the aponeurosis. In all, the mass had extended beyond the anterior extremity of M<sub>1</sub> along the digital nerves into the subcutaneous interspaces. Likewise in all, the mass had extended between and around the slips of the flexor digitorum brevis into M<sub>1</sub>, whence the usual spread took place.

*Extension from M<sub>2</sub> (Fig. 9).* In most of the specimens, the mass in M<sub>2</sub> lay deep to the fascia covering the quadratus plantae muscle

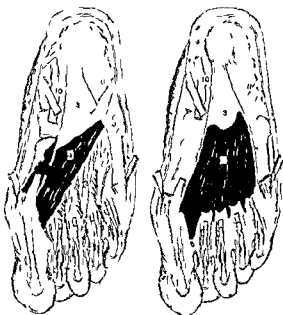


Figs 10a b c and d Diagrammatic drawing showing spread of injection mass from M<sub>1</sub> 2 M<sub>2</sub> 3 M<sub>3</sub> 4 M<sub>4</sub>

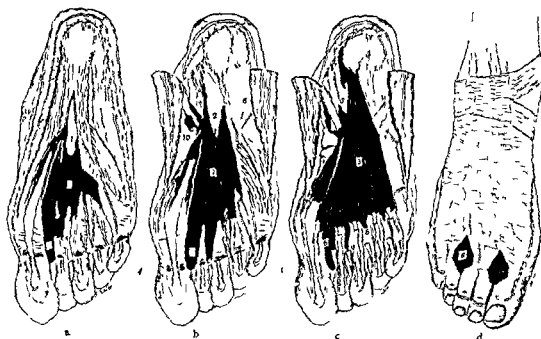
5 lumbrical spaces 6 lateral plantar space 9 dorsal subaponeurotic space 1 medial and 11 lateral leg space

The most common extensions from this space were into M<sub>3</sub> (100 per cent) into the lumbrical spaces (100 per cent) and into M<sub>1</sub> (75 per cent). In no case did the spread into M<sub>3</sub> go posterior to the base of the fifth metatarsal bone. It occurred anteriorly between and around the slips of the quadratus plantae muscle. Along the lumbrical muscles the mass had spread a variable distance—in some cases to their insertions dorsally. In some, the mass was confined within the sheaths of the muscles or more commonly between those sheaths and the overlying fascial coverings, but in others it had broken through to be more superficially. There were no possible routes of extension from M<sub>2</sub> into M<sub>1</sub> one by first spreading to the lumbrical grooves and from there along the subcutaneous interspaces into M<sub>1</sub>, and the other by breaking through and around the slips of the flexor digitorum brevis directly into M<sub>1</sub>. There was evidence of spread by both routes in our specimens.

In 50 per cent, there was an extension through the medial wall to the crossing of the long flexor tendons with more or less spread



Figs 11a and b Diagrammatic drawing showing spread of injection mass from M<sub>4</sub> 3 M<sub>3</sub> 4 M<sub>4</sub> 5 lumbrical space 10 medial leg space 11 lateral leg space



Figs 12a b c and d Diagrammatic drawing showing spread of injection mass from lumbrical spaces 1 M1 2 M2 3 M3 5 lumbrical spaces 6 lateral plantar space

8 dorsal subcutaneous space 10 medial leg space 11 lateral leg space

from there proximally along both tendons and distally along that of the flexor hallucis longus. In about an equal number, there was a spread proximally along the lateral plantar structures as far as or above the annular ligament. Less frequent extensions from M2 were proximally along the medial plantar structures (25 per cent) and laterally into the space under the abductor digiti quinti (25 per cent). The latter apparently took place along the vessels perforating the common septum between those spaces.

**Extension from M3 (Fig 10)** The most common extensions were through the medial wall to the crossing of the long flexor tendons (90 per cent), into M2 (75 per cent), and into the lumbrical spaces (75 per cent). In some the spread to the long flexor tendons was confined to the area of crossing, but in others the mass extended proximally along both tendons to, or even beyond, the annular ligament and distally along the flexor hallucis longus tendon toward its insertion. In one specimen the injection had broken into the synovial

sheaths of the long flexors and had extended to their upper limits above the malleolus. The spread into M2 varied in amount, but in every case had occurred anteriorly between and around the deep flexor slips. In the extensions into the lumbrical spaces, the mass lay deep to the sheaths of the muscles in some but in others had broken through them and the overlying fascia to become more superficial. Distally, the lumbrical masses passed a variable distance—even to the insertions of the muscles dorsally.

About 50 per cent of the injections extended into M1, either directly or secondarily from M2 or the lumbrical grooves. There was direct extension into M4 in 40 per cent and in an equal number there was a break through the posterior medial extremity of M3 to the medial side of the calcaneus, deep to the posterior tibial and lateral plantar structures but separated from them by a definite layer of fascia. Another 40 per cent showed spread through the distal half of the second and all of the third and fourth interosseous

spaces into the dorsal subaponeurotic space. Less frequent was the spread along the deep side of the flexors to the toes to, or almost to, the metatarsophalangeal joints. In one specimen, the mass had broken into the synovial sheath of the third toe, extending to its distal end. Other infrequent extensions were through the lateral wall to the deep side of the flexor digiti quinti brevis and through the medial wall to the deep side of the flexor hallucis brevis muscle.

**Extension from M4 (Fig 11)** In every case there was extension into M3. This was to be expected from the small size of M4 and its close anatomical relationship to M3. In about half of the cases, the mass broke through the first and proximal half of the second interosseous spaces to reach the dorsal subaponeurotic space. In 30 per cent there was extension through the medial wall to the deep side of the flexor hallucis brevis muscle.

**Extension from lumbrical spaces (Fig 12)** About 90 per cent of these injections showed breaks superficially into the subcutaneous portions of the lumbrical tunnels, from which the mass in most cases extended into M1 or superficially over the plantar aponeurosis or both. Almost as many (80 per cent) showed extension into the dorsal subcutaneous space at the insertions of the muscles. Extension into M2 superficially to muscles and into M3 deep to them occurred in 70 per cent.

**Extension from lateral plantar space (Fig 13)** The most common spread from this space was through its medial and lateral walls to the subcutaneous regions adjacent (100 per cent). In 66 per cent, there was extension into M2 through the common septum between the first break occurring along the vessels piercing that septum. In a like number, there was spread through the floor or lateral wall to peroneus longus tendon then proximally and distally along this tendon.

**Extension from medial plantar space (Fig 14)** This space was quite independent of the other foot spaces. The only consistent spread from it was through its medial and lateral walls subcutaneously.

**Extension from region behind medial malleolus (Fig 15)** The most common route of extension from the region deep to the deep

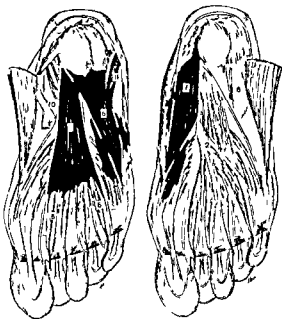
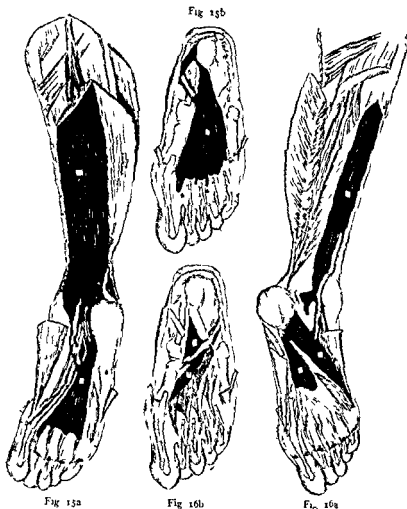


Fig 13 (left) Diagrammatic drawing showing spread of injection mass from lateral plantar space 2 M2 5 lumbrical spaces 6 lateral plantar space 10 medial leg space 11 lateral leg space

Fig 14 Diagrammatic drawing showing spread of injection mass from medial plantar space 2 M2 6 lateral plantar space 7 medial plantar space

fascia behind the medial malleolus was proximally into the intermuscular space between the superficial and deep calf muscles and even farther, along the posterior tibial and the popliteal structures (100 per cent). Distally the mass was most apt to go deep to the medial space under the abductor hallucis muscle along the lateral plantar structures into M2 (80 per cent), along the medial plantar structures to the subcutaneous region medial to M2 (80 per cent), along the flexor hallucis longus (80 per cent) and flexor digitorum longus (40 per cent) tendons for a variable distance, and finally from the medial side of the calcaneus into M3 (20 per cent). When the synovial sheaths of the long flexors were entered they ruptured proximally and distally, with increasing pressure, and the mass took the course described.

**Extension from region behind lateral malleolus (Fig 16)** The injections into the synovial sheaths of the peronei were either localized within those sheaths or broke through proximally to the upper third of the leg or distally



Figs 15a and b Diagrammatic drawing showing spread of injection mass from region behind medial malleolus. 1 medial leg space 2 medial leg space 3 lumbrical spaces 4 lateral plantar space 5 lumbrical spaces 6 lateral plantar space 7 medial leg space 8 lateral leg space 9 lateral leg space

Figs 16a and b Diagrammatic drawing showing spread of injection mass from region behind lateral malleolus. 1 medial leg space 2 medial leg space 3 lumbrical spaces 4 lateral plantar space 5 lumbrical spaces 6 lateral plantar space 7 medial leg space 8 lateral leg space 9 lateral leg space

into the foot. The latter extension was most often into the lateral space under the abductor digiti quinti from which further spread into  $M_2$  was common. Spread also occurred subcutaneously at the lateral border of the abductor or deeply along the peroneus longus tendon into the depths of the foot from which location the mass often went into  $M_3$  and  $M_4$ . The injections, superficial to the synovial sheath but deep to the deep fascia

traveled up the leg within the muscle sheaths rather than distally into the foot—the resistance to the flow apparently being less upward

#### INCISIONS FOR DRAINING FASCIAL SPACES

The above study of dissections and injections of the fascial spaces has suggested some anatomical methods of approach for draining infections of these spaces.  $M_1$  may be opened from the plantar side but although this is

the most logical approach, it has the objection of leaving a scar on the sensitive plantar surface of the foot which may be a source of discomfort later. In addition, one must keep in mind that septa divide  $M_1$  into several compartments and that these septa must be broken down to open up all pockets of pus.

$M_2$  may also be opened from the plantar side but this procedure is open to the same objection as that for  $M_1$  and in addition necessitates going through the flexor brevis muscle with resulting poor drainage and later possible loss of function. The plantar approach to  $M_3$  and  $M_4$  is open to all the above objections, and in addition there is the danger of injury to the lateral plantar structures crossing the floor of  $M_2$ . A much better method of approach to  $M_2$ ,  $M_3$ , and  $M_4$  is from the medial side. A study of Figure 5 shows that all of these spaces have a common medial wall which separates them from the flexor hallucis longus and brevis and more medially from the abductor hallucis muscles. An incision on the medial side of the foot, opposite the anterior surface of the first metatarsal bone, leads under the abductor hallucis and flexor hallucis brevis muscles to the common medial wall from which any of the median plantar spaces may be easily entered by pushing a hæmostat through at the proper level. Since infection is apt to spread from one to the other of the median spaces a method of approach that gives access to all of them is doubly valuable. Counter drainage may be obtained by advancing the hæmostat to the lateral wall of the space opened into and from there to the plantar surface at the superficial margin of the third plantar interosseous muscle to which the lateral wall is attached. Counter drainage from the lateral side along the anterior surface of the fifth metatarsal bone is interfered with by the superficial position of the third plantar and fourth dorsal interossei which would have to be cut through in such an approach. The opening medially into  $M_3$  may be extended posteriorly by following the tendon of the flexor hallucis longus to its crossing by the flexor digitorum longus and entering  $M_3$  deep to that crossing.  $M_2$  may likewise be entered superficial to the crossing

In an infection of a lumbrical space, the latter should be opened just as in the hand, from the medial side of the proximal phalanx to the proximal end of the space (on a line between the middle of the fifth and the head of the first metatarsal bones). If there has been extension to the dorsal subcutaneous space, the incision should likewise be extended dorsally from its distal end. As most lumbrical space infections are accompanied by involvement of the median plantar spaces, it may be necessary to open into the latter from the proximal end of the lumbrical incision a hæmostat directed proximally deep to the lumbrical muscle entering  $M_3$ , superficial to it  $M_2$  and along the digital nerve  $M_1$ . For additional drainage, the median spaces should be opened from medial side as stated.

Infections in the lateral space under the abductor digiti quinti are best drained through the lateral wall of that space and those in the medial space under the abductor hallucis through the medial wall. These are easily taken care of but if spread occurs to other spaces, the latter must be opened in the manner described for them.

Dorsal subaponeurotic infections are apt to remain localized and are easily opened from the dorsum of the foot, but if they are secondary to infections in  $M_3$  or  $M_4$ , through and through drainage must be instituted.

Infections in the deep leg space between the superficial and deep calf muscles are best drained by incisions on both sides of the tendo achillis extended proximally along the borders of the gastrocnemius and soleus to the upper third of the leg. Through and through drainage may be established. On the medial side the incision may be extended distally behind the malleolus along the long flexor tendons and posterior tibial structures.

Infections along the peronei should be opened directly over those muscles and the incisions extended proximally or distally as indicated.

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## THE POSTURAL TREATMENT OF POSTOPERATIVE MASSIVE ATELECTATIC COLLAPSE<sup>1</sup>

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**T**HOUGH postoperative massive atelectatic collapse of the lung has been accepted by the profession as a clinical entity the etiological factors producing the condition, its mode of production, and by what methods it can best be terminated once it has occurred are problems which are still under discussion. Our data is derived for the most part from the study of 14 cases which have occurred at this hospital during the years 1925 to 1928 inclusive. The pathological data was obtained from the necropsy reports of Bergamini and Shepard and Pasteur's description of his fatal cases as none of our cases have terminated fatally during the presence of the disease.

We thought it would not be amiss to review the disease as we have encountered it in this relatively large group of cases, so that the process might be more clearly outlined clinically.

**Definition.** Postoperative massive atelectasis of the lung is a reaction of an obstructive nature in which the affected part of the lung becomes airless, characterized by displacement of the mediastinal contents to the involved side, decreased radiability of the affected lung tissue, a high diaphragm and flattened chest on the same side, increased respiratory and pulse rate, cyanosis, and usually a rather abrupt onset within 48 hours after an operation or injury.

**History.** W. Pasteur (18) in 1890 first described the condition from a study of 34 cases, he supplemented this in 1908 with his Bradshaw Lecture (19) and in 1914 with another paper (20). Since then a number of excellent articles have been written on the subject, especially those of Bradford Scott (28), and Sante. Of interest is the fact that most of the authors believed the condition to be neurogenic in origin, but it now appears that the pendulum is swinging toward the theory that obstruction causes the condition,

as was pointed out first by Elliott and Dingley, and later by Chevalier Jackson and Walter L. Lee.

**Sex.** Males and females are equally liable to the disease, in our series of 14 cases the sexes were equally divided.

**Age.** Age seems to play but little part in the condition in our group. The ages ranged from 12 years to 64 years. However, 6 of the cases were in the third decade.

**Season.** Ten of the cases occurred in the first 3 months of the year, March alone having 6 to its credit, and it would seem from this that there is a seasonal variation in the incidence of the disease.

The type of operation seemed to play no part in its promotion as there were three cholecystectomies, two gastric operations, four pelvic operations, four appendectomies, and one exploratory laparotomy. It is interesting to note that in a series of 2,346 operations performed at this clinic on patients with intracranial neoplasm, no case of massive atelectatic collapse of the lung has been noted.

**Anesthesia.** Eleven patients received ether alone and the remaining three had nitrous oxide gas and oxygen supplemented by ether.

**Lung affected.** In 13 cases the right lung was involved, and in 10 the right lower lobe was affected. The whole left lung except the extreme apex was involved in the remaining case.

**Mode of production.** We believe that collapse of the lung is primarily due to obstruction of a bronchus or several bronchi by tenacious mucus and not by a mucus plug. This, we believe, accounts for the absence of postmortem findings demonstrating an actual obstruction, as a foreign body type of mucus plug has usually been expected. This obstructing material is of primary importance; however, there are several secondary factors which greatly facilitate the collapsing of pulmonary tissue, namely, limited excursion of



Fig 1



Fig 2



Fig 3

Fig 1 Case 1. Film taken at 10 o'clock showing diffuse cloudiness of the whole right lung with consolidation of the lower lobe, displacement of the heart and trachea to the involved side and a flattening of the right chest wall. The right diaphragm is obscured.

Fig 2 Case 1. Showing definite clearing of the right lung. The trachea has returned to its normal position. The

heart is still slightly displaced to the right and the right diaphragm is still slightly higher than normal but is now visible through the partly aerated lower lobe.

Fig 3 Case 1. This film 4 hours after the onset of the disease shows only a slight residue of the atelectasis in the right base. The mediastinal contents are in their normal position but the right diaphragm remains slightly elevated.

the diaphragm and thorax the habitus of the patient during or following operation, both causing a decreased aeration of the lungs, and probably a raised threshold value of the cough reflex favoring stagnation and drainage of the secretions into the dependent lung for if the patient occupies the supine position the right lung will be the one affected in at least four of five cases because of the anatomical structure of its primary bronchus.

That the condition does not occur contralateral to the side operated on unless the contralateral side is dependent, we feel is shown by our series of cases in which atelectasis developed on the right side in all but one case, even though there were three McBurney incisions, eight right rectus incisions, and three in the midline. Further the fact that the right lung and especially the right lower lobe are so much more frequently affected than the left forces us to dismiss the theory of a predisposed pulmonary nervous mechanism as of primary importance.

As to the site at which deaeration commences, we feel that in the milder cases the obstructing material is only sufficiently great to close off the smaller bronchioles but from this point the process may extend to the larger bronchi, or the original site of obstruc-

tion with tenacious mucus may be in one or more of the larger bronchi, with a consequent involvement of a larger area of the lung. Following the obstruction the air in that part of the lung tissue, the bronchus of which is obstructed is absorbed by the pulmonary circulation. The absorption of the gases tends toward a negative pressure in the tissues involved and makes conditions optimum for secretion from the cells lining the bronchioles and also permits or assists fluid to permeate the capillary walls and fill the alveolar cells, which we believe accounts for the heavy congested lungs and hydropic alveolar cells which have been found at postmortem.

That the first step in collapse of the lung after the obstruction has occurred is the absorption of air from the alveoli was demonstrated in one of our cases. The first X-ray film showed the mediastinal structures to be displaced, a high diaphragm was present, and the chest wall appeared retracted, but there was no increased density of the lung. Subsequently, however, the lobe became less radiable and the picture was complete.

Conversely when the patient is treated the chest structures do not return to normal positions until secretion has been coughed up, and only then does lung become more transparent.



Fig 4



Fig 5



Fig 6

Fig 4 Case 2. A film taken at 4 p.m. shows a marked clouding with involvement of right lung except extreme apex laterally. Trachea and heart are displaced to affected side.

Fig 5 Case 2. Shows a marked clearing of the right lung while the heart and trachea have returned almost to

the midline. However there is still slight clouding around the right hilus.

Fig 6 Case 2. Showing further clearing of the right lung with but very slight displacement of the heart and trachea to the right.

**Morbid anatomy.** Grossly, the affected lung tissue appears smaller than normal, congested, grayish in color, and sinks in water. The lung feels solid, is airless and does not crepitate. Thick tenacious mucus is frequently found in the bronchi.

**Microscopically,** the alveolar epithelial cells appear closely packed together and are swollen and hydropic. The capillaries are dilated and congested. The smaller bronchioles are collapsed while the larger ones remain of normal caliber.

**Symptoms.** The disease usually occurs within 48 hours after operation, although it may occur as late as 6 days following operation. The onset clinically may be abrupt or more gradual, depending on the site of obstruction, whether involving a large bronchus or one of the smaller bronchi respectively. There is a rise in the temperature, although usually only moderate. The respiratory rate is increased and appears to bear a definite relation to the rapidity of onset as it varies directly with the abruptness of onset in many cases. The pulse rate is also increased and depends considerably on the preceding two factors. The patient has no pain; he lies by preference on the affected side and his breathing is labored, hasty, and jerky. The apex nasi may dilate with inspiration. In the cases with abrupt onset cyanosis

is usually present. Cough is usually absent, although several of our patients have complained of a sensation of 'something beneath the sternum which they could not raise'. Expectoration is slight if any during the actual tenure of the disease, but is great in amount, as is the cough when the secretion is being expelled. The expectoration, however, is not blood tinged.

**Physical signs.** The patient usually lies on the affected side or at least inclines toward it. In the severe cases there is marked respiratory distress, i.e. cyanosis, polypnea and hyperapnea and the patient looks extremely ill. The respiratory rate ordinarily is around 40 per minute, although in one of our cases the rate was 60 per minute. Movements of the apex nasi are frequently seen. When only a small portion of the lung tissue is collapsed there is no appreciable change in the size or motion of the two sides of the chest. However, when one or more lobes are involved, there is a definite decrease in the expansion of the involved side and a compensatory increase on the normal side. The point of maximum intensity of the heart beat is displaced toward the involved side.

Palpation confirms inspection as to the decrease in expansion of the diseased lung and also to more accurate localization of the



Fig 7



Fig 8



Fig 9

Fig 7 Case 3. Showing an early collapse with definite displacement of the mediastinal structures, flattening of chest wall and beginning de-aeration of right lung.

Fig 8 Case 3. Re-examination of chest (portable) shows clouding of the right base obscuring diaphragm. The heart and trachea are nearer midline than before. This may be due to exudate in the atelectatic lower lobe.

Fig 9 Case 3. Third examination of the chest (portable) shows a mottled clouding of the right base but much less than at last examination. The diaphragm still remains elevated but the heart and trachea have returned to their normal position. This marked clearing is probably due to postural drainage of the massive atelectasis.

maximum impulse of the heart beat. A friction rub may be felt. Tactile fremitus may be decreased or unaffected, depending on whether the obstructive mechanism predominates or whether the signs transmitted from neighboring patent bronchi predominate.

Percussion confirms palpation as to the location of the point of maximum impulse of the heart. The percussion note may be either dull or flat on the affected side while hyperresonance of the normal lung is common. The diaphragm on the involved side is high and immobile (Litten's sign is positive).

Auscultation confirms the position of the heart. The auscultatory findings in the lungs may be divided into the following types:

1. Signs of obstruction—the breath sounds are suppressed or merely diminished in intensity. Associated with this we find a decrease in the intensity or absence of whispered and spoken voice. Again in this form few fine rales, if any, are heard.

2. Signs of consolidation—in this form we get tubular breathing and increased whispered and spoken voice sounds. Rales are numerous and vary from the fine crepitant rale to the harsh piping rale so commonly heard in asthmatics.

Further, the above findings are elicited during the onset or actual duration of the disease. However, when the obstruction has been relieved and the patient is coughing up a good deal of mucoid material, rales of all types are heard, and harsh breathing is found. The physical signs may change rapidly, which alone might suggest this condition.



Fig 10 Case 3. Fourth examination of chest (portable) shows definite clearing in the right base. There is now only moderate increase in the markings to the right base along the heart. The latter is apparently in normal position.

*Complications* Only one of our cases developed a complication of a pulmonary nature (interlobar pleurisy), and we are of the opinion that they are very infrequent. However, the occasional finding at autopsy of a completely airless, shrunken, and fibrosed lobe (Mallory<sup>1</sup>) may indicate the possible complication of an organized atelectasis.

*Relapse* One patient (Case 5) developed a slight atelectasis on the opposite side. He had been instructed to lie with the left side down and several days later developed a slight atelectasis of the left lower lobe.

Another patient (Case 4) had a recurrence of the process in the same lung three times in the space of 6 days during her illness. It should be stated, however, that the process did not clear completely between the apparent relapses but did so only partially.

*Clinical varieties* These are two in number: (1) Malignant or fulminating type. In this form a patient who is convalescing satisfactorily suddenly becomes cyanotic, has marked dyspnea, and appears in *extremis*. The respirations are around 60 per minute, pulse is small and rapid, and at times it may reach 140 or more. (2) Insidious. This is the usual mode of onset. In this form a day or two after operation it is noted that the patient is not doing as well as he should. The temperature either remains or becomes elevated, the breathing is somewhat more rapid than usual, and examination demonstrates signs of intrapulmonary changes, often rapidly changing in type. Sometimes the condition is not recognized until cough attracts the physician's attention to the chest. From the study of our cases the diagnosis of atelectasis is seldom made from the physical examination alone.

*Prognosis* Postoperative massive atelectasis is rarely fatal in itself and deaths should occur only in the simultaneous bilateral cases if such may occur. With our present knowledge of the disease practically all clinical evidence of the condition should be absent in 48 hours when the proper treatment is employed. An elevated diaphragm and slight displacement of the mediastinal structures may persist for a number of days but is of little significance.

<sup>1</sup> Personal communication.

*Diagnosis* Probably no acute pulmonary affection is so frequently missed as the disease under discussion. It seems that the condition is not thought of and therefore not diagnosed in a large majority of the cases occurring today. To decrease the number of cases undiagnosed or wrongly diagnosed, it might be well to keep in mind the following maxim: "Any postoperative patient that develops pulmonary symptoms and signs within 36 hours after operation should be considered as a case of massive collapse until proven otherwise."

The direct diagnosis is made on finding a displacement of the mediastinal contents to the diseased side, findings consistent with consolidation of the lung, a high diaphragm on the same side, and decreased size and mobility of the chest affected.

Roentgenograms of the chest will demonstrate such findings more clearly than physical examination, for the latter is seldom sufficient except in the cases in which marked atelectasis is present. X-ray films of the chest are indispensable in the diagnosis of minor degrees of atelectasis. The disease is most commonly confused with bronchopneumonia, from which it can be differentiated by the lack of displacement of the mediastinal contents.

Simultaneous bilateral postoperative collapse of the lungs has never been diagnosed in the living as far as we know, and its occurrence theoretically would be incompatible with life. However, marked elevation of both diaphragms is frequently seen in chest films of postoperative patients but without the deaeration of the lungs and displacement of the mediastinum. The consequent diminution of available lung space may force hyperventilation and thus prevent the obstruction of bronchi or bronchioles and typical atelectatic collapse.

*Prophylaxis* There are several procedures which appear to be worthy of routine use: (1) Hyperventilation of the lungs during and after operation with carbon dioxide and oxygen as advocated by Scott and Cutler who have demonstrated that by so doing the incidence of massive collapse is diminished by three-fourths. (2) Change of position of patient every 6 hours after operation to prevent ac-



Fig 11



Fig 12



Fig 13

Fig 11 Case 4. Four days after operation. This film shows opacity of the left chest except for a small clear area at the apex. The heart is displaced to the left, the diaphragm is high and the ribs appear retracted.

Fig 12 Case 4. Slight spontaneous clearing of the left upper lobe.

Fig 13 Case 4. Recurrence of atelectasis, now almost complete in the left lung.

cumulation or stagnation of secretions in the dependent portions of the lungs, (3) curtailment of postoperative sedatives, especially those which depress the cough reflex and thereby favor stagnation of secretions.

**Treatment.** The active treatment consists of two procedures: (1) postural and (2) bronchoscopic.

The postural treatment, as first advocated by Sante (25), is simple, safe, and can be carried out by anyone anywhere. It consists in turning the patient so that the sound lung is dependent, the patient being in a horizontal or slight Trendelenburg position; the latter in case either of the lower lobes are involved. The patient should be kept in this position for a short time, encouraged to cough gently and to breathe as deeply as possible. Gently rolling the patient from side to side or light manual percussion over the involved area may be of considerable assistance in raising mucus. This procedure may be repeated at intervals as often as is necessary, but the patient should not be kept in this position for any length of time as the disease may shift to the dependent lung. This apparently happened in our Case

reported in detail and the roentgenograms accompany the cases. Brief abstracts of 10 other cases that have occurred in this hospital since 1925 are also recorded.

**CASE 1.** J. F. Surg. No. 29634, Med. No. 30711. A white married male of 60 entered the hospital on September 13, 1927, for cholecystectomy, which was

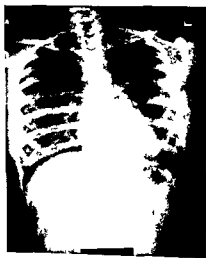


Fig 14 Case 4. Film of the chest at discharge, 2½ months after operation and atelectasis. Complete restoration to normal, but fluoroscopy showed limited movements of the left diaphragm.

5. Five cases which it has been our privilege to observe and treat by postural drainage are

performed the following day, under novocain and ether anæsthesia. For the next 2 days the temperature fluctuated around 99 pulse 100 and respirations around 25 per minute. On September 16 the temperature went to 101.6 degrees maximum, the pulse varied from 84 to 120 respirations from 30 to 40 per minute. Examination of the chest at 9 a.m. showed a marked diminution of respiratory movement on the right. The breath sounds were absent over the entire right chest with bronchial breathing over the left chest. The percussion note of the right chest was dull. The left chest was hyperresonant. Spoken voice was transmitted but diminished over the right chest. A few fine râles were heard at the left base. The heart was markedly displaced to the right both by percussion and by auscultation of the heart sounds. The patient had a chest film taken at this time (Fig. 1).

The patient was returned to the ward and instructed to lie on his left side and the right side was firmly percussed. Within 30 minutes he began to cough violently and he raised about 100 cubic centimeters of thick tenacious mucopurulent sputum. During the next 4 hours he continued to raise lesser quantities of sputum. At 1 o'clock the patient felt markedly improved. At 2:30 p.m. auscultation revealed breath sounds coming through over the right chest and numerous crackling râles were heard. At 4 o'clock the patient was returned to the X-ray room where another film of the chest was taken (Fig. 2).

At 8 o'clock the temperature had dropped to 99.5 degrees pulse to 84 and respirations to 30 and the patient was resting quite comfortably.

On the following day September 17 a third examination of the chest was made (Fig. 3).

The patient's temperature and pulse became normal from this date on but his respiratory rate remained elevated (around 30) for another day.

On September 28 another film was taken which showed complete clearing of the lungs. There remained slight bronchial thickening in the right base and fluoroscopy showed some limitation of the right diaphragm.

The patient was discharged free of symptoms on September 20 1927 15 days after operation.

CASE 2 N I S Surg No 25334 The patient was a white boy of 12 who entered the hospital on March 6 1927 complaining of pain in the abdomen. A diagnosis of subacute appendicitis was made and on March 7 1927 under a combined anæsthesia of gas and ether an appendectomy was performed through a right rectus incision. It was noted that considerable mucus was brought up during the operation. The temperature was 101.8 pulse 120 and respirations 30.

The following day his temperature had gone to 103 (102 minimum) pulse 130 and respirations were 48 per minute the white blood cells remaining at 15,000.

Examination of the lungs at this time revealed dullness and diminished excursion on the right side

suppression of breath sounds in the right axilla and right base posteriorly, while over the rest of the lung the breath sounds were bronchial in character. At this time he had a marked cough but no chest pain and was cyanotic in appearance. X-ray examination showed a massive atelectasis (Fig. 4) on the right side.

During the evening the patient was instructed to lie on the uninvolved (left) side. Very shortly after turning the patient on his left side he expectorated a large quantity of sputum which was followed by quite a noticeable decrease in the cyanosis and he felt definitely better.

On March 9 the maximum temperature was 101.8 degrees pulse 130 and respirations 42 per minute. There still remained some decrease in excursion on the right side and the percussion note was dull at the angle of the right scapula. The breath sounds were heard faintly over the involved area while bronchial breathing was heard over the right apex posteriorly. X-ray examination (Fig. 5) showed definite clearing of the right lung.

The next day the respirations had fallen to 30 per minute the maximum temperature was 101 degrees pulse 130 and there was only a slight limitation of expansion on the right with normal tactile fremitus over the lung except at the extreme right base where it was slightly diminished. The breath sounds were audible over the previously silent area.

On March 11 he was still running an increased respiratory rate of 24 to 32 per minute but his temperature had dropped to 100 maximum and pulse to 110. The patient was feeling definitely better and was sitting up in bed. He continued to cough and expectorate a copious amount of mucus. Physical examination now revealed bronchial breathing with coarse crepitant râles over the affected area with increased tactile fremitus and X-ray examination showed (Fig. 6) only a slight residue of the massive atelectasis.

During the next few days he continued to improve and he was discharged on March 24 17 days after operation.

CASE 3 J C Surg No 30878 A single white male of 24 entered the hospital on March 8 1928 for a gastro-enterostomy. Physical examination showed nothing abnormal.

On March 12 1928 the patient was operated upon under ether anæsthesia and it was noted that he had a tendency to an accumulation of mucus in his throat. A right rectus incision was made and a resection of the pylorus and first part of the duodenum with a posterior gastrojejunostomy (Pólya) was done.

On the first postoperative day the patient's temperature rose to 102 degree pulse to 120 respirations to 48 per minute. Examination of the chest revealed some crepitant râles at both bases more marked on the right. No definite displacement of the mediastinal contents was noted. An X-ray film of the chest (portable) showed an early but definite



Fig 15



Fig 16



Fig 17

Fig 15 Case 5 There is apparent displacement of the trachea and heart to the right with elevation of the right diaphragm but no particular clouding of the right lung The findings suggest a mild degree of postoperative massive atelectasis—not definite due to rotation of patient

Fig 16 Case 5 Roentgenogram after postural treatment and cough There is now definite clearing of the

right base and return of the heart and trachea to the midline

Fig 17 Case 5 After 3 hours of passive postural drainage there is definite clearing of the right base the lower lobe now appearing patchy instead of solid and the diaphragm is visible The mediastinal structures have returned to the midline

massive atelectasis with clouding of the right lung elevation of the right diaphragm and displacement of heart and trachea toward the involved side (Fig 7)

On the second postoperative day the patient had a sharp pain in the right chest and his temperature fluctuated between 97.2 and 102 The pulse ranged from 90 to 110 and the respirations from 24 to 25 At this time examination of the chest revealed dullness at the right base diminished breath sounds and tactile fremitus and numerous râles could be heard over the whole area Portable X rays showed complete de aeration of the right lower lobe (Fig 8)

The patient was instructed to lie on his left side and made to cough forcibly Shortly he commenced bringing up large amounts of tenacious mucus Following this the area of dullness over the right lower lobe disappeared and breath sounds became normal Tactile fremitus became normal and the patient felt much better Portable X rays demonstrated re aeration of the right lower lobe (Fig 9) and the following day (Fig 10) the lung was almost normal in appearance

The patient was discharged free of symptoms on March 28 16 days after operation

CASE 4 M. K. R. Surg. No. 30179 A white female of 13 entered the hospital on November 7 1917 with an acute attack of appendicitis

Physical examination showed marked rigidity of the entire abdominal wall with exquisite tenderness throughout but more marked on the right There were a few râles noted in the left chest Temperature was 102 degrees white blood cells 12,300

Under gas oxygen and ether anesthesia a low right rectus incision was made and a ruptured appendix was found A general peritonitis was

present The appendix was removed and ample drainage was provided

On November 30 it was noted that there were numerous râles over the whole left chest The temperature varied from 101.6 degrees to 101.6 degrees pulse 104 to 124 and respirations 35 to 55 per minute

On December 1 an X ray film of the chest was taken, which showed a well established massive atelectasis on the left side (Fig 11) Portable films of the chest were made daily, and the patient was



Fig 18 Case 5 After 18 hours of passive postural drainage the massive collapse has shifted from the right lower lobe to the left lower lobe and the heart and trachea are displaced to the left side



considered as a control for the cases treated by postural drainage as she was too sick to be moved. The massive atelectasis alternately cleared slightly and recurred (Figs 12 and 13) over a period of 37 days, with three separate and distinct remissions and relapses during this period and finally disappeared. The patient ran a fever and a high pulse during this period but the respirations remained elevated only about a week suggesting that she accommodated herself to the loss of air space rather promptly. The peritonitis was also overcome gradually, and she was discharged on February 14, 1928, after 2½ months in the hospital. A film of the chest just before discharge (Fig 14) showed no essential variation from normal except that the left diaphragm was limited in mobility.

CASE 5 P L Surg No 30561 A Greek carpenter of 43 years entered the hospital on January 26, 1928 with a diagnosis of duodenal ulcer, confirmed by X ray examination.

Physical examination was negative except for some spasm and tenderness in the right upper quadrant. White blood cell count showed 12,600.

On January 27, under gas oxygen and ether anesthesia the patient was operated upon and a cholecystectomy performed, no ulcer being demonstrable. Recovery from the operation was uneventful until the third day when the patient presented signs of a pulmonary complication and a portable roentgenogram of the chest was made which showed a mild atelectatic collapse of the right lung (Fig 15).

This was confirmed by another film the following day and on the third day of his postoperative complication at 6 p.m. careful physical examination revealed the following: Both sides of the chest apparently were symmetrical and moved equally. Percussion showed an area of dullness at the right base posteriorly from about the eighth rib to the base medially and extending around laterally to the lower part of the axilla. On auscultation no breath sounds or râles could be heard over this area of dullness (Fig 16).

The patient was then instructed to lie on his left side and to cough whenever he felt like doing so. He remained in this position for 2½ hours and during this time he coughed considerably and raised a great deal of thick tenacious sputum. This was not blood streaked.

At 9 p.m. the right chest was re-examined and the percussion note was found to be more resonant than at 6 p.m. On auscultation at this time the breath sounds were audible over the previously silent area and some coarse bubbling râles could be heard. Another roentgenogram was taken (Fig 17) which showed partial clearing of the right lower lobe. The patient spent most of the night lying on the uninvolved side, raising mucus at intervals.

On February 4 examination of the chest showed the heart to be in normal position and the lungs showed no definite evidence of consolidation. The breath sounds were somewhat diminished at both bases. A film of the chest showed marked clearing

of the right base, but also showed elevation of the left diaphragm and partial clouding of the left base with displacement of the heart toward the left indicating an atelectasis on this side in other words a transference due to the patient's position of the process from right base to left base (Fig 18). That day the patient passed a tarry stool there were repeated hemorrhages the 3 following days and death ensued on February 8, 12 days after operation. Chest films on the intervening days showed clearing of both bases. Autopsy showed an ulcer on the posterior wall of the duodenum, with a bleeding artery in its base as the cause of death. The lungs were essentially negative except for more intrabronchial secretions than normal and extensive fibrous adhesions of visceral to parietal pleura on the left. No atelectasis was demonstrable.

The 9 remaining cases in our series were not treated by any particular method and all recovered spontaneously. They will therefore, be reviewed only very briefly.

CASE 6 M A S Surg No 23021 A 59 year old woman had a panhysterectomy under ether anesthesia on January 9, 1925. A low midline rectus incision was used. The onset of the collapse was gradual, the first evidence of a pulmonary complication being a rise of temperature on the seventh postoperative day. The first X ray film was made on the seventeenth day after operation and revealed a mild collapse and an interlobar pleurisy both on the right. Re-examination 7 days later still showed some displacement of the heart and mediastinum to the right. She was discharged convalescent the next week, 32 days after operation.

Her maximum temperature was only 100 degrees pulse 116 and respirations 28 per minute.

CASE 7 E I G Surg No 23910 A white woman of 26 years with a history of pleurisy 8 years ago and bronchopneumonia had a cholecystectomy performed on May 23, 1925 under ether anesthesia. A right rectus incision was used. Her first symptom was a spell of coughing and shortness of breath on the second day postoperative when physical examination demonstrated a diminution of breath sounds over the right lower chest anteriorly and posteriorly and later a friction rub. X ray examinations revealed a mild collapse of the right lower lobe and marked clearing the next day which followed the expectoration of thick mucoid material. A third examination 12 days later showed slight mediastinal displacement persisting. She was discharged 16 days after operation.

Her maximum temperature was 101.2 degrees pulse 130 and respirations 40 per minute.

CASE 8 N R, Surg No 23708 A white boy of 17 had an appendectomy on February 14, 1925 under ether anesthesia. A muscle splitting incision was used. On the second day after operation the temperature rose suddenly to 102 degrees pulse to 140 and respirations to 40 per minute. Physical

examination revealed an immobile right chest car diast dislocation, dullness over middle and lower lobes on the right faint and distant breath sounds with bronchial breathing. A portable film of the chest showed almost complete collapse of the right lung sparing only the apex. Four hours later no breath sounds could be heard through the right chest anywhere except in the infraclavicular region and there only faintly. The white blood cells had risen from 8000 the day of operation to 30400 the second day after operation. X ray films showed beginning clearing the third day after operation progressing gradually, but there was still a definite residue at last examination on the tenth day. This patient was discharged on the twenty third post operative day.

His maximum temperature was 102 degrees pulse 140 respirations 40 per minute.

CASE 9. B W Surg No 24969. A man of 64 years had an exploratory laparotomy on October 17 1925 revealing inoperable lymphoma of the terminal ileum. Ether anesthesia was used. Cough and considerable sputum were noted on the third day with a temperature of 102 degrees pulse 84 and respirations 24. On the sixth day dyspnea was present and examination showed dullness all over the right chest hyperresonance on the left, and cardiac dislocation to the right. Breath sounds were bronchial over the right chest posteriorly distant anteriorly. X ray films October 24 showed massive collapse of the whole right lung unchanged the following day with gradual aeration beginning in the lower lobe 6 days later (13 days after operation). The last film 18 days after operation showed the mediastinum in normal position but the right lung remained cloudy. He was discharged December 3 17 days after operation.

His maximum temperature was 102 degrees pulse 98 respirations 24.

CASE 10. M W Surg No 23387. A white woman of 29 years had a salpingectomy appendectomy and ventral suspension of the uterus done on March 11 1925 under ether anesthesia. A low mid line incision was used. The onset of her collapse came the following day with cough cyanosis and mucus in the throat. Labored respirations were noted the second day and examination revealed crepitant râles at both bases with bronchial breathing at the right base. X ray films showed collapse of the right lower lobe and the following day showed definite clearing. No further roentgenograms were taken. This patient was discharged on the eighteenth day after operation.

Her maximum temperature was 101 degrees pulse 140 respirations 30 per minute.

CASE 11. A P Surg No 25858. A white woman of 50 years had an appendectomy, supracervical panhysterectomy and a colporrhaphy on March 1 1926 under ether anesthesia. The incision was recorded as supra pubic. The first symptom was cough on the day after operation but examination was negative. On the second day the cough was

worse, coarse crackling râles were found and a roentgenogram revealed a mild collapse of the right lung elevated diaphragm displaced heart, but only a diffuse clouding on the right no localized de aeration. She recovered promptly, no further X ray films being requested and she was discharged on the eighteenth day after operation.

Her maximum temperature was 101 degrees pulse 120 and respirations 30 per minute.

CASE 12. A V G Surg No 27749. A white woman of 13 years had a Gilliam suspension of the uterus and an appendectomy done on December 9 1926 under ether anesthesia through a mid line suprapubic incision. The following day she complained of 'phlegm' in her throat and her temperature was 102.8 degrees, pulse 128 respirations 24 per minute. The second day after operation a friction rub was found over the entire right chest anteriorly with numerous fine moist râles and bronchial breathing below the clavicle and in the upper part of the right axilla. She began to expectorate a very thick purulent but odorless, greenish sputum. X ray films showed partial collapse of the right lung with irregular small areas scattered through all three lobes (X ray pictures of the lungs before operation had revealed nothing abnormal). Her condition remained unchanged for 9 days, but no further roentgenograms were taken. She was discharged on the twenty second day after operation.

Her maximum temperature was 102.8 degrees pulse 148 respirations 30 per minute.

CASE 13. K A C, Surg No 25848. A white woman of 27 years had an appendectomy done on March 1 1926 under ether anesthesia through a right rectus incision. The first symptom of a post operative pulmonary complication came 48 hours after operation with a sore throat purulent sputum and pain in the right lower chest. Physical examination revealed moderate dullness on percussion over the right base posteriorly bronchial breathing over this area and a friction rub but no displacement of the heart was noted. A portable film of the chest showed clouding of the right base with some displacement of the heart and trachea to the right. In addition there was a small area of increased density in the left upper lobe laterally. No further X ray examinations were called for as she improved rapidly coughing up considerable purulent sputum meanwhile. She was discharged 13 days after operation.

Her maximum temperature was 101 degrees pulse 120 and respirations 40 per minute.

CASE 14. D E M Surg No 28408. A white male of 27 years was operated upon for gastric perforation on March 14 1927, under ether anesthesia. A right rectus incision being used. The perforation was found and closed no gastro enterostomy being done. Early on the second postoperative day the patient suddenly became dyspnoic was very cyanotic, and his breathing was labored. He was lying on his right side. Physical examination at this time showed marked limitation of respiratory move

ment on the right, with increased respiratory excursions on the left. Tactile fremitus was present on both sides. The percussion note over the right lower lobe anteriorly was dull, and there was bronchial breathing over this area. A roentgenogram showed the lower half of the right chest to be opaque, obscuring the right diaphragm and the heart and trachea were displaced to the side. A re-examination the following day showed more displacement of the mediastinal contents, but the clouded area remained unchanged. The signs and symptoms lasted for 5 days slowly decreasing in intensity, no further x-ray films being made. He was discharged April 1, 1927, 16 days after operation.

The maximum temperature was 102 degrees, pulse 140 and respirations 42.

The cases reported above have afforded us an opportunity to obtain a few facts which are significant, i. e., Cases 3 and 5 have shown quite definitely that the first step in the production of the disease is the occlusion of the air passages, followed by the absorption of the air, and then the next step is the displacement of the mediastinal contents towards the affected side, and an elevation of the diaphragm. Then, with the absorption of more air from the alveoli and conditions for further displacement of the diaphragm and mediastinal contents becoming more difficult, there is a pouring out of secretions from the cells lining the bronchi, and an exudation of serum through the vessel walls into the bronchi where a tendency toward a negative pressure exists. The obstructing material which is essential to the production of the disease is the thick, tenacious mucus which does not form a mucus plug, but rather more probably a diaphragm of mucus over the lumen of the air passages. Clearing of the consolidated area occurs first when the condition is abating and this is followed by a return of the mediastinal contents to their normal position.

Case 4 has shown that we may have a recurring massive atelectasis. This patient had three definite spontaneous remissions and relapses, but the disease (untreated) lasted 37 days.

Case 5 demonstrates that massive collapse may be transferred from one lobe to another lobe, the deciding factor being gravity. Case 5 also proves that massive atelectasis may occur in one lung even though the opposite

lung is restricted by extensive pleural adhesions.

We wish to call attention to the frequency of this disease, the methods of prevention, the postural method of treatment, the infrequency of clinical diagnosis (2 out of 14), and the ease of recognition if roentgen examination is made routinely in all cases with postoperative pulmonary complications.

#### CONCLUSIONS

1. Obstruction to the air passages is absolutely essential for the production of the disease. Thick tenacious mucus is the obstructing material.

2. Usually many secondary factors are involved in the production of the disease, i. e., lowered vital capacity, raised cough reflex, lack of frequent postural change after and during operation, and limitation of thoracic and abdominal mobility due to the operation.

3. The disease is not a reflex nervous phenomenon.

4. The condition does not occur contralateral to the side operated upon unless the patient lies on his side during the operation, as in renal operations.

5. The Sante maneuver is very efficacious in treating the disease.

6. Hyperventilation of the lungs with carbon dioxide and oxygen should be employed at the end of operation and during the first 48 hours postoperative.

7. Frequent changes of posture should be made during the first few days after operation, and sedatives should be curtailed.

8. The mortality from the disease is very low.

Since the original presentation of this material before a clinic of the American College of Surgeons in Boston October 10, 1923, several articles on the subject have appeared. Of prime importance are the ones by Bowen (Am. J. Roentgenol. & Radium Ther. 1929) and by Lee, Tucker, Ravdin and Pendergrass (Arch. Surg. Jan. 1929). The latter gives a complete account of the experimental production of this disease in dogs and proves beyond a doubt that obstruction of the air passages is the primary factor in the causation of postoperative massive atelectatic collapse and that the important contributory factor is the abolition of the cough reflex.

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## TUMORS OF THE CAROTID BODY

ARTHUR DEAN BEVAN M D AND EARL R. MCCARTHY M D CHICAGO

THE carotid body was first described as the "Ganglion minutum" by von Haller in 1743. This knowledge soon was forgotten but Neubauer in 1783 once more brought it to light. Shortly thereafter, 1797, Andersch gave a good description and named the body at the bifurcation of the common carotid artery the "Ganglion intercaroticum." Interest again waned until 1862 when Iuschka published his splendid report containing detailed microscopic studies of this peculiar structure. Since that time it has been extensively studied by many men and its various characteristics are gradually becoming clear, although many points are still a matter of dispute. A patient with carotid tumor was recently admitted to our service, and this gave us the opportunity of studying this condition.

The patient (Mr. E. T. M.), 39 years of age, was referred to Dr. Bevan by a physician who for some time had been treating him for syphilis. While he was under specific treatment he developed a nodule in the left side of the neck just below the angle of the jaw, the nodule pulsated. It was at first small and just palpable. It increased gradually in size until it was about as large as an English walnut. There had been very few symptoms in connection with the nodule, possibly some tingling or twinges hardly severe enough to classify as pain. The medical man who had him under treatment for syphilis for a period of 3 years from 1923 to 1926 thought at first that it might be specific but it did not disappear under treatment and he then concluded that it might be a tuberculous gland and referred him for operation and treatment.

We also thought that under the circumstances the most probable diagnosis was a tuberculous gland although we felt that the diagnosis was uncertain. We advised an exploratory operation which was made last October under local anesthesia. A very thorough physical examination was made before the operation. The mass which was the size of a walnut gave one the impression of pulsation. It seemed however that when the pulsation was examined carefully it probably was a transmitted pulsation from the carotid and not the expansile pulsation of an aneurism (although the possibility of aneurism had to be considered). There was another feature about the case that impressed us—that was that the mass was very freely movable from side to side but not from above downward. The operation was performed under local anesthesia. The operative field

was infiltrated with novocain and adrenalin solution. An incision on the inner side of the sternocleidomastoid dividing the skin and superficial fascia—the platysma and the deep fascia surrounding the entire neck—was made. Making a very careful and complete dissection we exposed the common carotid for the distance of about 2 inches and the internal carotid and the external carotid to a point above the tumor. At the crutch of the common carotid a tumor about the size of an English walnut, of a brownish purplish red color was found. The mass looked as though it was exceedingly vascular and made up largely of loops of blood vessels. From its location and the character of the tissue it was quite evident that we had to deal with a tumor of the carotid body. The tumor involved the wall of all three carotids the common, the external and the internal. The sketch of the neck was made by Mr. Shephard at the time of the operation (Fig. 1). The tissue between these great vessels and the tumor was infiltrated with novocain solution and an attempt made to dissect the tumor from the blood vessel walls but it was found that it would be impossible to make a complete removal of the tumor without removing the common carotid and the internal and external carotids to which it was attached.

One of us, Dr. Bevan, has done a great many ligations of the three carotid vessels, possibly one hundred or more. The great majority of these have been ligations of the external carotid as a preliminary step in the amputation of the tongue, in removing extensive carcinomata from the mouth and in resecting the upper jaw also extensive carcinomata of the face and the side of the neck. Probably 80 per cent of these carotid ligations have been operations of this kind in which the ligation of the external carotid was done for the purpose of controlling hemorrhage.

The common and internal carotids were also ligated in possibly twenty five cases. About half of these have been cases of pulsating exophthalmos due to skull fractures and injury of the internal carotid in the cavernous sinus. The other half of the ligations have been in cases of extensive neck dissections in malignant disease, and a few of them in very extensive vascular neoplasms of children in which it was necessary to ligate both the common carotid and internal jugular in which the vascular

neoplasm was supplied by both the internal and the external carotid

These facts are cited because this experience has made us very familiar with the enormous mortality that results from ligation of the common carotid and internal carotid from cutting off the blood supply of that side of the brain, with a resulting necrosis of the brain tissue and death of the patient. There is, as is well known, an enormous difference in the risk of ligating an external carotid from that of the internal carotid or common carotid. We have had practically no mortalities in our very large series of external carotids, on the other hand, we have had a number of fatal and serious accidents in ligating the common and the internal, the ligation of the internal being the most serious of the three. Statistics covering a large number of cases show that in the neighborhood of 30 per cent of ligations of the common and internal carotids are followed by death of the patient.

As we stood in the operating room with this patient on the table, with the tumor and the carotid vessels exposed, these facts flashed through our minds. The patient was under local anesthesia, so without any hardship to him one of the assistants went down to the library and brought up a volume of Keen's *Surgery* containing an article on tumors of the carotid body which one of the assistants read to the operating group.

Although it was a great temptation, with the complete dissection which had been made, to remove this tumor, the "Golden Rule" was applied. Ask yourself what you would want done with your knowledge as a surgeon under these circumstances if you were the patient, and you will recognize the fact at once that you would not want your carotid vessels ligated and take the chance of 30 per cent mortality from the operation with the added chance of hemiplegia following the operation even though you survived it. We felt very positive in our position when we realized that the majority of these tumors are not malignant and the patients live for 20 to 30 years or longer with tumors of the carotid body without ever becoming malignant or without their producing symptoms of moment. We, therefore, made the operation purely exploratory,

closed the incision, and decided to see what could be done by radiation in the way of reducing the size of the tumor or possibly bringing about a cure.<sup>1</sup>

This is the first carotid tumor that we have operated upon. Very few surgeons have operated upon more than one, a few have operated upon two cases, and no one has reported more than three. In other words, no one has had a large enough experience to dogmatize on the subject, at least from the standpoint of his own limited experience with these cases. We felt, therefore, that it would be wise to review the entire literature of the subject for the purpose of determining the best method of handling these cases.

#### ANATOMY

The carotid body is of variable size, from 5 to 7 millimeters long, 2.5 to 4 millimeters wide, and 1 to 1.5 millimeters thick. Its location is not absolutely constant, at times being in the middle of the bifurcation of the common carotid artery, at others directly behind it, while sometimes it lies on the medial posterior surface of the internal carotid just at the bifurcation. It has a definite fibrous capsule and is connected to the wall of the carotid, either internal or external, by a fibro adipose pedicle about 2 or 3 millimeters long called the ligament of Mayer. It is through this pedicle that the nutrient vessels run. The color varies from gray red to purple red, depending upon the amount of blood present. It is usually homogeneous with a smooth surface but sometimes it is broken up by septa into many loosely connected parts. The arteries to the gland by most authors are stated to come from the common or internal carotids. This is doubtful however, in view of the recent splendid work of Smith who shows that in all animal embryos studied, except the pig and including the human, the artery is derived from the external

<sup>1</sup>November 8, 1929. Thirteen months have now elapsed since the operation. The patient was observed today and states that the tumor has absolutely no symptoms referable to tumor. The mass has almost entirely disappeared. The carotid pulsation can be felt much more distinctly on this side than the other because at the operation the deep cervical fascia was divided for the extent of 4 or 5 in. in parallel with the incision. This has permitted the common carotid and its point of division into the internal and external to come much nearer to the surface. To date the patient has had no return X-ray treatments. The result of these treatments must be accepted as having produced practically a cure, and it seems to point to the conclusion that the treatment with the X-ray with its very slight danger is much to be preferred to the operative treatment of these tumors which carries with it the enormous mortality of more than 30 per cent.

carotid and that the branch comes off before the origins of the occipital and ascending pharyngeal. The veins are variable but usually come off the upper pole of the gland and empty into the superior laryngeal, pharyngeal or lingual. The nerves supplying the carotid body, and with which it is richly endowed are derived from the pharyngeal branch of the ninth nerve and the superior cervical sympathetic ganglion and the sympathetic trunk. Some authors claim that it has branches from the vagus and hypoglossal as well but this is not proved.

#### HISTOLOGY

From the inner surface of the fibrous connective tissue capsule fibrous septa enter and divide the gland into lobules which in turn are divided into lobuli by smaller trabeculae of the same connective tissue network. This fibrous network is rich in nuclei and many medullated and non medullated nerve fibers, as well as ganglion cells are present. The lobuli are made up of clusters of cells of different types. The majority are large polyhedral cells rich in protoplasm which is finely granular and poor staining. The individual cell walls are sometimes difficult to distinguish. The nuclei are large, round or oval somewhat eccentrically placed, and deep staining. Some authors state that scattered throughout the cellular elements are cells having an affinity for the salts of chromium but this is disputed. There are also scattered sympathetic ganglion cells, plasma cells and eosinophilic cells present. There is no regularity of cell arrangement.

There is an exceedingly rich capillary network which in places enlarges to form large sinuses. The lining layer of endothelial cells is thin and the lobuli cells are not separated from them by stroma. Many times these capillaries are flexed upon themselves and become hunched. This gives the appearance of a glomerulus and has given rise to the name 'glomus caroticus' (Fig. 1).

It must be remembered that the histological picture of the carotid gland undergoes a change with the age of the individual. In childhood and youth the gland is small—about the size of a millet seed—and the cellular elements predominate. As the individual grows older, the gland also grows larger to

about the size of a bean, and the capillaries and stroma increase at the expense of the cellular elements.

#### EMBRYOLOGY

There is a marked difference of opinion concerning the origin of the carotid body. The different theories may be grouped under three headings: (1) epithelial, (2) vascular, (3) nervous. The advocates of the first of these theories believed that the carotid body was derived from the pharyngeal epithelium. There is at present no evidence supporting this theory. The second or vascular origin is upheld by Arnold, Waldeyer, Schaper and others. They believe that the body is derived from the blood vessel wall, either endothelial or perithelial. Waldeyer introduced the term perithelial body to differentiate it from endothelial. The nervous origin is upheld by Stillé, Kohn, and others. These believe that the development is from sympathetic ganglion cells of the intercarotid plexus. In a detailed study of the origin and development of the carotid body, Smith concludes that it arises from a complex of materials which become associated during the developmental history of the third mesodermal arch. A portion of the mesenchyme of the third arch should be regarded as the anlage of the mesodermal constituents of the body and not as a localized area of the wall of the carotis interna. The nervous elements are derived from a pharyngeal branch of the glossopharyngeal nerve as well as from the cervical sympathetic and sometimes from vagus. This phase of the subject needs much further study.

#### PHYSIOLOGY

Relatively little work has been done in this field, and that which has been done is almost barren of results. Moulon, Gomez, Scaffidi, Vassale, Lanzillatta, and Frugoni all did work the results of which in some cases conflict. Moulon in 1904, prepared an extract from the carotid gland of horses injected it into rabbits and noted a rise in blood pressure and acceleration of the pulse. He concluded that it acted like adrenalin. Gomez in 1907 injected a glycerine extract of the body into cats and found a fall in blood pressure.

Scaffidi destroyed the carotid bodies of calves and observed no ill results. Vassale destroyed the carotid bodies of cats on both sides with cautery and immediately thereafter noted a glycosuria which persisted for about 4 days. The animals never again developed a glycosuria but gradually became cachectic lost their fur, and died about 6 months after operation. Lanzillatta observed a transient glycosuria from destruction of the sympathetic trunk or superior sympathetic ganglion. Frugoni has shown, by perfusion experiments in rabbits using a calf's carotid body perfusate, that this perfusate has a vasodilatory effect. If such an extract is injected intravenously there is a short initial rise, then a marked fall in blood pressure with a gradual rise to normal. Fischer extirpated both carotid bodies from young cats. The bones of these animals developed a condition resembling osteomalacia and the parathyroids hypertrophied. There is no definite evidence that the carotid body has any endocrine significance. The results of extirpation experiments are nil because it is impossible to remove the carotid body without severe trauma to the cervical sympathetic which, of course, clouds any results that may be obtained. Injections and perfusions of extracts by Frugoni as above, gave results that could be explained on other bases. Its marked vascularity suggests an active metabolism.

#### PATHOLOGY

The only congenital anomalies noted are those of differences in shape or location. It may be a single body divided into many nodules by the capsular septa or there may be several separate lobes only loosely connected by a fascia. Likewise it may be in the fork of the carotid or on the posterior surface of the internal or external carotid artery.

Paunz has noted hæmorrhages in the newborn, especially in premature babies and associated with hæmorrhages in other neck structures. He has also noted them following thyroidectomy and in purpura especially purpura hæmorrhagica.

Gomez reports a few cases of sclerosis by which he means an increase in the connective

tissue stroma. He states that this occurs in old age in individuals with syphilis of the carotid artery and that the sclerosis is directly proportional to the amount of sclerosis of the intima of the vessel. This vessel sclerosis also affects the interlobular vessels in the carotid body, the lobuli cells atrophy, the stroma increases, and may even undergo hyaline degeneration. Schaper claims that these changes are due to age entirely (Paunz reports these changes present in individuals dying of cirrhosis of liver). In the 50 postmortem cases examined by Gomez, he found one case of cloudy swelling in a patient dying of lobar pneumonia. In another case dead of chronic nephritis, he found a lymphoid infiltration affecting only one lobule. Paunz also found round cell infiltration in hydrophobia. Amyloid degeneration of the small vessels has been noticed.

Deitrich and Siegmund state that suppuration, abscess formation and phlegmon have occurred.

With these exceptions the carotid body seems to be peculiarly unaffected by general disease processes. It is however not uncommonly the site of tumor formation. These tumors have been called various names: endothelioma, perithelioma, perithelial hæmangioma, adenoma, paraganglioma, neuroblastoma, fibroangioma, hamartoma, phæochromocytoma and others. Perithelioma suggested by Paltauf and based on the presumed origin of the carotid body seems to be the choice of most pathologists. These tumors are essentially a hyperplasia of the cells of the normal carotid body. In almost all cases they produce on a larger scale the normal histological picture of the cell groups of large pale staining cells containing well defined oval nuclei and with more or less indefinite limiting membranes the groups separated by fibrous trabeculae and having a rich capillary network as well as many ganglion cells. Occasionally giant cells are present. There may be round cell and plasma cell infiltration and there may also be areas of degeneration with hæmorrhage. There is no regular arrangement of the tumor cells. Some cases are definitely malignant, and in these tumor cells may be found infiltrating the vessel walls and invading the



capsule Kopfstein, Keen, and Kretschmer report cases with regional lymph gland involvement Gilford and Davis report one case with metastases in the liver, but it is questionable if this case is one of carotid body tumor as is also true of the patient of Moenckeberg who died of papillary adenocarcinoma of the ovary 4 years after removal of a carotid body tumor These are the only two cases reported of metastases There are 24 cases (17.8 per cent) of malignancies reported There are 12 cases (8.9 per cent) of definite recurrences in the literature Some of the cases reported as malignant may not have been so because of the disagreement as to the type of tumor This is illustrated by two cases of Burge and one of Fowler Unless tumor cells can be demonstrated invading the tumor capsule or vessel walls, with or without regional lymph gland involvement, it is very difficult if not impossible to make a diagnosis of malignancy in these cases The accompanying photomicrographs are made from specimens of the tumor removed by Dr Carl B Davis in 1920, and reported by Dr E. F. Traut in 1927 They show the characteristic features of the tumor (Figs 5 and 6)

#### DIAGNOSIS

A correct pre-operative diagnosis of these tumors is seldom made Only fourteen such diagnoses are on record This is mainly because of the rarity of the tumor No one man has ever had more than three cases come under his observation In all cases there is a visible tumor mass usually in the upper anterior cervical triangle with the posterior margin under sternocleidomastoid muscle This tumor mass is of variable size some being as small as a hazelnut others as large as a goose egg Usually they are of hen's egg size when the patient first consults a physician The mass practically always pulsates but the pulsation is not that full expansion and contraction of an aneurism but rather a sort of transmitted pulsation In most cases firm pressure on the mass will considerably diminish its size, since this forces the blood out of the highly vascular mass There may be a thrill and a bruit The skin of the neck is unchanged and it is freely movable over the

tumor mass The mass itself is movable laterally but not up and down and is almost always unattached to surrounding structures The surface is usually smooth but in several cases it has been nodular Practically never do patients with carotid tumors complain of pain, although there may be occasional tingling sensations in the neck The mass is not tender to palpation

The associated symptoms that may be present are almost all pressure effects The vagus cervical sympathetic, and recurrent laryngeal are the structures most commonly thus affected Knighton reports a case in which the patient had fainting spells due to vagus pressure and Boot reports one with Stokes Adams syndrome Hoarseness and cough are relatively common Dysphagia, dyspnoea, tinnitus aurium, headache, dilatation of the pupil have been noted

The tumor is practically always unilateral It occurs at any age, the youngest case on record is 7 years, and the oldest is 73 It is most frequent between the ages of 30 to 40 and practically 70 per cent of the cases occur between 30 and 60 years The average age of 126 patients was 41.7 years

In 131 cases that have recorded the sex of the patients 64 cases were males and 67 were females

TABLE I—ANALYSIS OF CASES

AGE INCIDENCE		Cases	Per cent
Years			
1 to 10		1	19.2
10 to 20		5	
0 to 30		18	
30 to 40		36	69.6
40 to 50		27	
50 to 60		24	
60 to 70		13	11.2
70 to 80		1	
SEX INCIDENCE			
Males			64
Females			67
Average age of patients 41.7 years			
Average duration of tumor before consulting physician			
years 2 months			
Total cases reported 143			
Number of postmortem cases 9			
Total cases reporting results of operations 125			
Total deaths malignancies included 44 or 35.2 per cent.			
Total deaths postoperative 27 or 21.6 per cent.			
Total malignancies and recurrences 33 or 17.5 per cent.			
Total recurrences 12 or 8.9 per cent.			
Total cases reported recovering 90			

Total cases with various postoperative disabilities 39 or 43 per cent  
 Total cases with common or all carotids ligated 62  
 Total number of deaths in these cases 21 or 33.8 per cent  
 Correctly diagnosed pre-operatively 14

From an analysis of this entire group it is clearly shown that an overwhelming majority of tumors of the carotid body are benign, certainly more than 80 per cent possibly not more than 15 per cent are malignant. Among malignant cases reported there are certainly a number which careful analysis would exclude from this group as they are probably lymphosarcomata and other malignant tumors which happen to involve the region of the carotid body, but certainly a number of them did not originate in the carotid gland but in the surrounding tissues. As shown in Table I in more than 30 per cent of the patients operated upon in which it was necessary to ligate the carotid artery the result has been fatal, and in a certain percentage ligations have been followed by aphasia and hemiplegia usually permanent in character.

#### SUMMARY AND CONCLUSIONS

With this evidence we wish to present the conclusion that in the future neoplasms of the carotid body should not be removed when it is necessary to ligate the carotid arteries in order to complete the operation. If the common carotid and the internal carotid can be saved by careful dissection done best under local anesthesia the removal of a benign tumor of the carotid gland would be justified. If the surgeon had definite and satisfactory evidence that the tumor was malignant the huge 30 per cent mortality involved in the ligation of the carotid arteries might be accepted in order to save the patient from death and from malignant disease. It is quite evident however that a malignant growth of the carotid gland involving these three arteries offers very little prospect of a permanent cure even by the most extensive operation.

We believe that these conclusions should be generally accepted and that they should control the actions of the surgeons who in the future are confronted as they usually are unexpectedly with this problem. It is true of course that in very few of these cases up to the present time has diagnosis been made

before operation, in practically none of them has a definite diagnosis of tumor of the carotid been made. With the amount of evidence which we now have and which has been accumulating in the last 20 years, the clinical diagnosis will be made more frequently in the future from three points: the location of the tumor at the crotch of the carotid, the sense of pulsation in the tumor, and the fact that the tumor is very movable from side to side but is not movable at all from above downward, and the added fact that the tumor has existed for many months or even years before the patient seeks surgical relief.

#### CASE 1 Operation by Reigner (67), 1880

Female aged 32 years had a tumor 4½ years. All carotids, internal jugular and pharyngeal arteries were ligated. Vagus and sympathetic nerves were injured. Clinical diagnosis was lymphoma but growth was proved to be malignant on pathological examination. Patient died of bronchopneumonia 3 days after operation.

#### CASE 2 Operation by Maydl (73), 1886

Male aged 28 years had a tumor 6 months. All carotids, pharyngeal and superior thyroid arteries were ligated. No clinical diagnosis was made. Pathological diagnosis was perithelioma. Postoperative aphasia and hemiplegia were unchanged 4 years later.

#### CASE 3 Operation by Dittel (73), 1886

Male aged 3 years, had a tumor for several months. All carotids and internal jugular arteries were ligated. No clinical diagnosis was made. Pathological diagnosis was perithelioma. Patient died of secondary hemorrhage.

#### CASE 4 Operation by Gersung (13), 1886

All carotids and pharyngeal arteries ligated. Clinical diagnosis was tuberculous glands of the neck. Pathological diagnosis was perithelioma. Patient recovered but suffered from paralysis of left vocal cord. This condition remained unchanged 4 years later.

#### CASE 5 Operation by Albert (73), 1889

Male aged 35 years had a tumor for 5 years. External carotid was ligated. No clinical diagnosis was made. Pathological diagnosis perithelioma. There was a recurrence one year later. Recurrent tumor was removed but patient was lost track of.

#### CASE 6 Kauffman and Ruppner (49), 1891

Female aged 25 years had a tumor for 7 years. Common and internal carotids and internal jugular were ligated. Vagus and hypoglossus nerves were injured. No clinical diagnosis was made but pathological diagnosis was carotid tumor. Hoarseness and contraction of pupil followed operation and patient died of pneumonia 2 days after operation.

#### CASE 7 Kretschmer (56), 1892

Male aged 48 years had a tumor 1 year. Superior thyroid, lingual arteries, and external jugular were

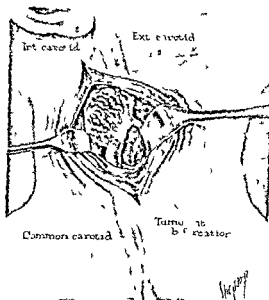


Fig. 1. Tumor at bifurcation of common carotid artery (Semi schematic)

ligated. Clinical diagnosis was branchial carcinoma but pathologically the growth was found to be a carotid tumor. There was postoperative paralysis of the left vocal cord. Recurrence took place in 4 months. Attempt was made to remove the recurrence but it was impossible. Patient was alive 14 months later.

**CASE 8 Maydl (55) 1893**

Female, aged 46 years, had a tumor for 16 years. All carotids, pharyngeal arteries and internal jugular were ligated. The sympathetic nerve was injured. Clinical diagnosis was carotid tumor. Pathological diagnosis was endothelioma. Patient recovered but mydriasis was marked.

**CASE 9 Maydl (55) 1895**

Male, aged 34 years, had a tumor 4 years. All carotids, pharyngeal, superior thyroid, lingual and external maxillary arteries were ligated. The vagus, facial, hypoglossus and sympathetic nerves were injured. The clinical diagnosis was carotid tumor and the pathological diagnosis was malignant tumor of endothelial type. Patient recovered from operation but suffered from aphonia and paralysis of the tongue and left vocal cord.

**CASE 10 Malinowsky (66) 1895**

Female, aged 30 years, had suffered from a tumor for 10 years. All carotids and internal jugular were ligated. Eight centimeters of vagus was resected. The clinical diagnosis was lymphosarcoma, pathological diagnosis perithelioma. Patient recovered.

**CASE 11 Middleton and Bjerring (69) 1895**

Male, aged 43 years, had a tumor for 6 months. The external carotid was ligated. No clinical diag-

nosis was made but the pathological diagnosis was carotid tumor. Patient recovered from operation but suffered from paralysis of the palate. Recurrence took place 2 months later and a tumor also appeared on the other side of the neck. Death occurred 3 months after operation.

**CASE 12 Moenckeberg (71) 1895**

Male, aged 52 years, had a tumor for 2 years. All carotids and the internal jugular were ligated. The vagus and hypoglossus nerves were injured. No clinical diagnosis was made but the pathological diagnosis was carotid tumor. After operation patient suffered from hemiplegia and aphasia. He died from pneumonia.

**CASE 13 Moenckeberg (71) 1895**

Female, aged 30 years, had a tumor for a year and a half. All the carotids were ligated. No clinical diagnosis was made but the pathological diagnosis was carotid tumor. Patient recovered from operation but had a right facial paralysis. Death occurred 4 years later from papillary adenocarcinoma of ovary.

**CASE 14 Moenckeberg (71), 1895**

Female, aged 50 years, had a tumor for 3 years. All carotids and the superior thyroid were ligated. No clinical diagnosis was made but the pathological diagnosis was carotid tumor. Patient recovered.

**CASE 15 Heinleth (45) 1900**

Male, aged 60 years, had a tumor for 37 years. No arteries or nerves were injured at operation. No clinical diagnosis was made but the pathological diagnosis was perithelioma. Patient recovered and there was no recurrence after 4 years.

**CASE 16 Dobromidoff (26) 1900**

Male, aged 41 years, had a tumor for 1 year. All carotids and the internal jugular were ligated. The vagus was injured. The clinical diagnosis was tumor of the thyroid, pathological diagnosis carotid gland tumor. Death occurred one day after operation.

**CASE 17 Simourchine (89) 1901**

Female, aged 41 years, had a tumor for 3 years. All carotids and internal jugular were ligated. The facial nerve was injured. Clinical diagnosis was fibrosarcoma but pathological examination showed the tumor to be either an endothelioma or a perithelioma. Patient recovered.

**CASE 18 Scudder (85) 1902**

Female, aged 31 years, had a tumor 9 years. All carotids were ligated. No clinical diagnosis was made but the pathological diagnosis was perithelioma. Patient recovered and had no recurrence in 4 years.

**CASE 19 Kauffmar and Ruppanner (49) 1902**

Female, aged 21 years, had a tumor 2 1/2 years. Clinical diagnosis was lymphoma or goiter, reported as carotid tumor. Patient recovered and had no recurrence in 4 years.

**CASE 20 Reclus and Chevassu (76) 1903**

Female, aged 49 years, had a tumor for 5 years. No ligations but sympathetic and branch of facial nerve injured. Clinical diagnosis carotid tumor.

and pathologically perithelioma Recovery Lower branches of facial paralyzed

CASE 21 Macphater (64), 1903

Female aged 34 years had a tumor 6 years All carotids and the internal jugular were ligated No clinical diagnosis was made and pathologically the type of tumor was undetermined Recovery no complications

CASE 22 Cuneo and Dainville (23) 1903

Female aged 23 years had a tumor 3½ years No ligations were made but the facial nerve was injured No clinical diagnosis was made Pathological examination showed carotid tumor Recovery

CASE 23 Funke and Hearn (35) 1903

Male aged 48 years had a tumor 6 years All carotids and the internal jugular were ligated The clinical diagnosis was fibroma or lipoma but the pathological diagnosis was perithelioma Patient recovered from operation but died 2 months later of cerebral anaemia

CASE 24 Gilford and Davis (36) 1904

Male, aged 52 years had a tumor of 3 months standing Internal jugular was ligated and the vagus and descendens hypoglossi were injured No clinical diagnosis was made, pathologically tumor was an endothelioma There was a recurrence in 6 weeks and death occurred in 5 months

CASE 25 Gilford and Davis (36) 1904

Male aged 62 years had a tumor 6 months All carotids and the internal jugular were ligated The vagus and descendens hypoglossi were injured No clinical diagnosis was made but the pathological diagnosis was carotid tumor Hemiplegia followed operation and death occurred from pneumonia the seventh day after operation

CASE 26 Gilford and Davis (36) 1904

Male aged 74 years had a tumor 1 year He died in 18 months of exhaustion Metastases were found in the liver

CASE 27 Keen (50) 1905

Male aged 56 years had a tumor 18 years All carotids and the internal jugular were ligated No nerves were injured Clinical diagnosis was lipoma Pathological diagnosis was perithelioma Death occurred 2 days after operation from oedema of the lungs

CASE 28 Dobromidoff (26) 1906

Female aged 25 years had a tumor 7 years All carotids and many veins were ligated No clinical diagnosis was made but the pathological diagnosis was carotid tumor Patient recovered but the pupil remained dilated and conjunctiva red

CASE 29 DaCosta (24) 1906

Male aged 52 years had a tumor 20 years All carotids and the internal jugular were ligated The superior laryngeal nerve was injured No clinical diagnosis was made but pathological diagnosis was carotid tumor Recovery Patient suffered from hoarseness and hemiplegia 8 days after operation

CASE 30 Liehenthal (60) 1906

Female aged 38 years had a tumor 10 months First operation was only a biopsy later one half of



Fig 2 Normal carotid body High power By H Klose (52)

tumor was removed No clinical diagnosis was made but the pathological diagnosis was perithelial hæmangioma The growth recurred but there were no metastases Death took place 9 months later from repeated hæmorrhage and cachexia

CASE 31 Graham and Crile (38) 1906

Male aged 27 years had tumor 10 years All carotids were ligated The vagus sympathetic and recurrent laryngeal nerves were injured No clinical diagnosis was made but the pathological diagnosis was perithelioma Patient recovered but with contraction of pupil and marked hoarseness No recurrence was evident 6½ years later

CASE 32 Binnie (14) 1906

Clinical diagnosis tuberculous adenitis pathological carotid tumor Patient recovered and had no complications

CASE 33 Coley (16) 1906

Male aged 53 years had a tumor 6 years The facial nerve was ligated Pathological diagnosis was mixed cell sarcoma of the carotid gland Patient recovered from operation but died from recurrence in 8 months

CASE 34 Kuznetsoff (57) 1907

Female aged 48 years had a tumor 2 years The external carotid was ligated No nerves were injured Clinical diagnosis was cervical adenitis or carotid tumor Recovery, no complications

CASE 35 Rivet (78) 1907

Female aged 49 years had a tumor 7 years No vessels or nerves were ligated or injured Clinical diagnosis was parotid or aberrant thyroid pathological diagnosis was carotid tumor Patient recovered but aphonia and difficulty in swallowing were present



Fig. 3. Normal carotid body. Low power. By H. Klose (52)

**CASE 36 Cook (22) 1907**

Male aged 32 years. All carotids and internal jugular were ligated. Clinical diagnosis was carotid aneurism. The pathological diagnosis was carotid tumor. Patient died 1 hour after operation from hemorrhage.

**CASE 37 Boni (10) 1908**

Female aged 34 years had a tumor 4 years. All carotids and internal jugular were ligated. The vagus and sympathetic were injured. Clinical diagnosis was carotid tumor. Pathological perithelioma or adenoma of carotid gland. Recovery no complications. No recurrence 2 years after operation.

**CASE 38 Cathcart (17) 1908**

Male aged 33 years had a tumor 2 years. All carotids were ligated. Pathological diagnosis was carotid tumor. Patient recovered and there was no recurrence 2 years later.

**CASE 39 Zondek (50) 1908**

Male aged 63 years had a tumor 9 years. All carotids were ligated but no nerves were injured. No clinical diagnosis was made. Pathological diagnosis carotid tumor. Patient recovered.

**CASE 40 Itini (58) 1908**

Male aged 28 years had a tumor 9 years. No arteries or nerves were injured. Clinical diagnosis was carotid tumor. Pathological struma of carotid gland. Patient recovered.

**CASE 41 Green (30) 1908**

Female aged 45 years had a tumor 17 years. No arteries or nerves were injured. Tumor was not removed.

**CASE 42 Green (30) 1908**

Female aged 7 years had a tumor 2 years. All carotids were ligated. No nerves were injured. Patient recovered but had a permanent hemiplegia.

**CASE 43 Makara (65) 1908**

Male aged 18 years had a tumor 2 years. All carotids and the internal jugular were ligated. No nerves were injured. A clinical diagnosis of accessory thyroid was made but the pathological diagnosis was alveolar tumor of the carotid gland. Hemiplegia and death occurred 3 days after operation of opening of the brain.

**CASE 44 Colev and Downs (27) 1909**

Male aged 35 years had a tumor 4 months. The external carotid and some branches were ligated. The pathological diagnosis was malignant carotid gland tumor. There was a prompt recurrence and death occurred in 4 months.

**CASE 45 Douglas (27) 1909**

Female aged 23 years. No arteries or nerves were injured. A clinical diagnosis of tuberculous aneurism was made but pathological examination showed perithelioma. Patient recovered but had a temporary paralysis of the vocal cord.

**CASE 46 Anquez (3) 1909**

Female aged 47 years had a tumor 9 years. The common carotid facial and lingual arteries were ligated. No nerves were injured. No clinical diagnosis was made but the pathological diagnosis was perithelioma. Recovery.

**CASE 47 Lillenthal (60) 1909**

Female aged 56 years had a tumor 30 years. All carotids and the internal jugular were ligated. Clinical diagnosis was carotid tumor. Pathological diagnosis was malignant perithelial hemangioma. Patient had a temporary aphasia and hemiplegia. She was cachectic for 3 years and death occurred 4 years after operation.

**CASE 48 Ligin (50) 1910**

All carotids were ligated but no nerve injury occurred. Pathological diagnosis was carotid gland. Recovery without complications.

**CASE 49 Mathers (68) 1911**

Male aged 23 years had a tumor 3 years. The external jugular was ligated. No clinical diagnosis was made but the operative diagnosis was carotid tumor. The tumor was not removed. Patient was reoperated upon by Dr. D. MacIherson in 1913. He removed tumor of ear. Patient still alive in 1914.

**CASE 50 Woolley and Fee (101) 1912**

Female aged 68 years had a tumor 2 years. All carotids were ligated. No clinical diagnosis was made but the pathological diagnosis was sarcomatous degeneration of carotid tumor. Patient died of septicæmia 23 days after operation.

**CASE 51 Chiari (10) 1912**

Male aged 31 years had a tumor 3½ years. The external carotid and the internal jugular were ligated. The *descentes hypoglossi* was injured. Clinical diagnosis of carotid tumor was confirmed on pathological examination.

**CASE 52 Hollaender 191**

Female. No arteries or nerves were injured. Pathological diagnosis was carotid tumor. She recovered but had a temporary recurrent laryngeal paralysis.

## CASE 53 Randisi (75) 1912

Female aged 55 years had a tumor 9 years. No arteries or nerves were injured. Clinical diagnosis was non malignant tumor of the neck. Pathological diagnosis, angiosarcoma. She recovered but had a right vocal cord paralysis.

## CASE 54 Da Costa (16) 1913

Female aged 36 years had a tumor 16 years. The external carotid was ligated. No nerves were injured. Clinical diagnosis was carotid tumor. Pathological diagnosis, perithelioma.

## CASE 55 Sinyshin (9) 1913

Female aged 9 years. Pathological diagnosis, tumor of carotid gland.

## CASE 56 Callison and Mackenty (9) 1913

Male aged 41 years, had a tumor 6 weeks. Biopsy was done first then patient was re operated upon for postoperative hemorrhage and the common carotid was ligated. Clinical diagnosis was lymphosarcoma but the pathological diagnosis was endothelioma or perithelioma. Infection set in with postoperative hemorrhage and hemiplegia. Death occurred 3 weeks after operation.

## CASE 57 Graham (38) 1913

Male aged 27 years had a tumor 7 years. The external carotid, facial arteries and internal jugular were ligated. The vagus was injured. The clinical diagnosis was tumor of the tonsil but pathological examination disclosed perithelioma. Patient recovered but pupil was contracted and he was hoarse.

## CASE 58 Reid (104) 1913

Male aged 46 years had a tumor 5 years. The common carotid and the internal jugular were ligated. The vagus and eleventh and twelfth nerves were injured. Clinical diagnosis was carotid aneurism but pathological diagnosis was adenoma of the carotid gland. Patient recovered.

## CASE 59 Reid (104) 1913

Male aged 47 years had a tumor 35 years. The internal jugular was ligated and the vagus was injured. No clinical diagnosis was made. The pathological diagnosis was carotid tumor. Death occurred on the operating table.

## CASE 60 Levings (4) 1913

Male aged 68 years had a tumor 3 weeks. The internal jugular was ligated. No clinical diagnosis was made but the pathological diagnosis was carotid tumor. Recurrence took place in 4 months. Death.

## CASE 61 Simmonds (88) 1913

Male aged 30 years. All carotids were ligated. No nerves were injured. No clinical diagnosis was made but the pathological diagnosis was paraganglioma intercaroticum. Hemiplegia and death followed operation.

## CASE 62 Simmonds (88) 1913

Female aged 67 years. No arteries were ligated and no nerves were injured. No clinical diagnosis was made but the pathological diagnosis was paraganglioma intercaroticum. Patient recovered.

## CASE 63 Neuber (72) 1913

Female aged 31 years had a tumor 6 years. The common carotid was ligated and the recurrent laryn-



Fig 4 Photomicrograph of carotid body tumor. High power.

geal was injured. Clinical diagnosis was lipoma. Pathological diagnosis, carotid tumor. Patient recovered but her voice was affected and she had paresis of the arm. There was no recurrence 4½ years after operation.

## CASE 64 Neuber (72) 1913

Male aged 30 years had a tumor 9 years. All carotids were ligated. The vagus and sympathetic were injured. No clinical diagnosis was made but the pathological diagnosis was perithelioma. Death occurred 2 days after operation of softening of brain.

## CASE 65 Neuber (72) 1913

Female aged 67 years. No clinical diagnosis was made but the pathological diagnosis was perithelioma. Patient recovered.

## CASE 66 Enderlen (20) 1913

Male aged 53 years. No ligations were done. No clinical diagnosis was made but the pathological diagnosis was tumor of the carotid gland. Patient recovered.

## CASE 67 Schmidt (84) 1913

Female aged 52 years had a tumor 20 years. The proximal end of the cut common carotid was sewed to the cut end of the internal carotid on the left side. Clinical diagnosis was tuberculous glands of the neck. Pathological diagnosis, carotid tumor. Patient recovered.

## CASE 68 Schmidt and Enderlen (84) 1913

Female aged 52 years had a tumor 20 years (same patient as Case 67 but on opposite side of neck, right). No ligations were made or nerves injured. The clinical diagnosis was carotid tumor and the pathological diagnosis was the same. Patient recovered but there was atrophy of the left half of the tongue. There was no recurrence for 1 year.



Fig 5 Photomicrograph of carotid body tumor Low power

**CASE 69 Groeneman (41) 1914**

Male aged 42 years had a tumor 2 years. The external and internal carotids were ligated the vagus was injured. No clinical diagnosis was made but the pathological diagnosis was carotid tumor. Patient had a left hemiplegia. Death.

**CASE 70 Balfour and Wildner (6), 1914**

Female aged 34 years had a tumor which had been present for some time. The internal jugular was ligated. Clinical diagnosis aberrant thyroid probable. The pathological diagnosis was malignant tumor of the carotid gland. Hemiplegia appeared 10 days after operation. One year later there was a recurrence and the hemiplegia persisted.

**CASE 71 Jopson and Kolmer (48) 1914**

Female aged 27 years had a tumor 2 months. The external carotid was ligated. No clinical diagnosis was made but the pathological diagnosis was perithelioma. Patient recovered and had no complications.

**CASE 72 Russel (80), 1915**

Female aged 25½ years had a tumor for 12½ years. All carotids were ligated but no nerves were injured. No clinical diagnosis was made but the pathological diagnosis was carotid tumor. Patient recovered but was slightly forgetful.

**CASE 73 Collier (21) 1915**

Female aged 50 years had a tumor 5 years. The common carotid was ligated. No clinical diagnosis was made but the pathological diagnosis was perithelioma. Recovery followed operation but patient had paralysis of left vocal cord.

**CASE 74 Steindl (92) 1915**

Female aged 30 years had a tumor 10 years. No ligations were made but the recurrent laryngeal and

sympathetic nerves were injured. Clinical diagnosis was metastatic carcinoma of the tongue or tuberculous adenitis. The pathological diagnosis was carotid tumor. Patient recovered.

**CASE 75 Owen (103) 1915**

Male, had a tumor 1 year. The external carotid was ligated. No nerves were injured. No clinical diagnosis was made but the pathological diagnosis was endothelioma of the carotid gland. Patient recovered and there were no complications.

**CASE 76 Coughlin (14) 1915**

Male. All carotids and internal jugular were ligated. The vagus was injured. No clinical diagnosis was made but the pathological diagnosis was carotid tumor. Hemiplegia occurred and death took place 2 days after operation.

**CASE 77 More (14) 1915**

A brother or sister of patient. Case 79 operated upon at the Mayo Clinic and the tumor was reported to be a carotid tumor.

**CASE 78 Burge (14) 1916**

Male aged 45 years had a tumor 7 months. No ligations were made and no nerves were injured. Clinical diagnosis tuberculous adenitis or carotid tumor. Pathological diagnosis endothelial sarcoma of carotid gland. Recovery took place with slight deltoid paralysis.

**CASE 79 More (14) 1915**

Female. No arteries or veins were ligated or nerves injured. Clinical diagnosis carotid tumor or branchial cyst. Pathological diagnosis carotid tumor. Patient recovered.

**CASE 80 Burge and Jenson (14) 1916**

Male aged 42 years. No clinical diagnosis was made but the pathological diagnosis was endothelial sarcoma of the carotid gland. Patient recovered.

**CASE 81 Schlev (83) 1916**

Male aged 37 years had a tumor 20 years. All carotids were ligated but no nerves were injured. No clinical diagnosis was made but the pathological diagnosis was carotid gland tumor. Patient recovered but there was temporary hoarseness.

**CASE 82 Shipley and Lunn (87) 1916**

Female aged 16 years had a tumor 2 months. All carotids and internal jugular were ligated. Clinical diagnosis sarcoma. Pathological diagnosis carotid tumor. Patient recovered. She had a rapid pulse for 5 days after operation. There was no recurrence 5 years after operation.

**CASE 83 Moresin (9) 1916**

Male aged 46 years had a tumor 15 years. No ligations were made or nerves injured. No clinical diagnosis was made but the pathological diagnosis was paraganglioma. Recovery.

**CASE 84 Winslow (100) 1916**

Male aged 24 years had a tumor 8 years. Common and internal carotid were ligated. No nerves were injured. Clinical diagnosis was carotid tumor and pathological diagnosis perithelioma. Patient recovered but voice was affected. No recurrence was apparent 13½ years after operation.

## CASE 85 Cahill and Taylor (15) 1917

Female aged 51 years had a tumor 8 years. The internal jugular was ligated and no nerves were injured.

## CASE 86 Gay (62) 1888

Female aged 24 years had a tumor 2 years (left side). No ligations were made or nerves injured. Clinical diagnosis tumor of neck. Recovery.

## CASE 87 Lund (62) 1917

Female aged 54 years had a tumor 16 years (right side)—this is same patient as Case 86. All carotids were ligated but no nerves were injured. Clinical diagnosis was carotid tumor and was confirmed by pathological examination. Patient recovered. Twenty nine years before she had had left sided tumor removed.

## CASE 88 Groenberger (40) 1917

Male aged 67 years. It was impossible to remove the tumor because it had extended into the mediastinum. Laminectomy was done for pain. Pathological diagnosis perithelioma. Death occurred 3 days after operation.

## CASE 89 Wetterdal (52) 1917

Male aged 47 years had tumor 6 months. The tumor infiltrated the vessels hence it was only partially removed. Pathological diagnosis carotid tumor. Death occurred 12 days after operation.

## CASE 90 Wetterdal (52) 1917

Female aged 56 years. No ligations were done and the nerves were not injured. Clinical diagnosis was tumor of the neck. Pathological diagnosis carotid tumor. Recovery.

## CASE 91 Fowler (33) 1917

Female aged 58 years had tumor 2 years. All carotids were ligated. The vagus hypoglossus and recurrent laryngeal nerves were injured. No clinical diagnosis was made. Pathological diagnosis was malignant carotid tumor with tendency to endothelial type. Patient recovered but was hoarse and had a cough.

## CASE 92 Cohn (20) 1918

Male. The internal jugular was ligated. The common carotid was only a fibrous cord. The clinical diagnosis was carotid tumor or lymphosarcoma. Pathological diagnosis carotid tumor. Death ensued in 10 days.

## CASE 93 Wiener (90) 1918

Female aged 37 years had tumor 8 years. All carotids and internal jugular were ligated. No clinical diagnosis was made but pathological diagnosis was perithelioma. Patient recovered. Patient had a partial right hemiplegia, right facial paresis and also paralysis of vocal cord. He was given X ray treatment after operation. No recurrence was noted 4 months later.

## CASE 94 Reenstjerna (77) 1919

Female aged 36 years had tumor 11 years. The external carotid was ligated and the recurrent laryngeal was injured. No clinical diagnosis was made but the pathological diagnosis was carotid tumor. Patient recovered but there was paralysis of the vocal cord.

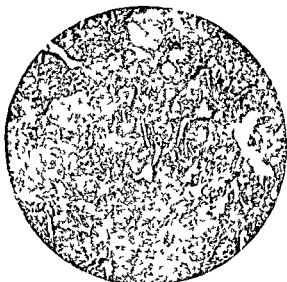


Fig. 6 Photomicrograph of carotid body tumor. Low power.

## CASE 95 Reenstjerna (77) 1919

Male aged 43 years had tumor 3 years. All carotids were ligated. No clinical diagnosis was made but the pathological diagnosis was carotid tumor. Patient died of hemiplegia 4 days after operation.

## CASE 96 Reid (104) 1919

Female aged 37 years had tumor 4 years. All carotids and the internal jugular were ligated. The vagus and hypoglossus were injured. No clinical diagnosis was made but the pathological diagnosis was round cell sarcoma of carotid gland. Treatment with radium had no effect. Operation resulted in recovery with paralysis of right vocal cord and deviation of tongue.

## CASE 97 Thompson (95) 1919

Male aged 56 years had tumor 20 years. All carotids and the internal jugular were ligated. No nerves were injured. Clinical diagnosis was carotid tumor or aneurism. Pathological diagnosis perithelioma. Patient recovered and there were no complications.

## CASE 98 Davis and Traut (96) 1920

Male aged 52 years had tumor 3 years. No ligations were made but the descendens hypoglossi was injured. No clinical diagnosis was made. Pathological diagnosis was carotid tumor. Hemiplegia appeared one day after operation and patient died in 5 days of bronchopneumonia.

## CASE 99 Keynes (51) 1921

Female aged 31 years had tumor 2 years. Clinical diagnosis was carotid tumor, pathological diagnosis endothelioma of carotid gland. Patient recovered but had a temporary paralysis of the orbicularis oris.

## CASE 100 Birman (9) 1922

Male aged 54 years had tumor 5 years. All carotids were ligated. No nerves were injured.



Clinical diagnosis was lymphoma but pathological examination disclosed carotid tumor

CASE 101 Klose (52) 1922

Female aged 30 years had tumor 8 years. The common carotid and internal jugular were ligated. The descendens hypoglossi and superior laryngeal were injured. Clinical diagnosis was carotid tumor and pathological examination confirmed this. Patient recovered.

CASE 102 Klose (52) 1922

Male aged 60 years had tumor 21 years. Clinical diagnosis was carotid tumor. He was not operated upon. An attempt to remove the tumor in 1902 was prevented by hemorrhage.

CASE 103 Descarpentries (79) 1922

Female aged 38 years had tumor 10 years. All carotids were ligated. No nerves were injured. Clinical diagnosis was adenitis. Pathological diagnosis was non-malignant carotid tumor. Patient recovered and recovery was permanent.

CASE 104 Ldve (79) 1922

Male aged 27 years. All carotids were ligated and the vagus was injured. Clinical diagnosis was cervical tumor. Pathological diagnosis carotid tumor. Recovery followed operation but paresis of one half tongue and hoarseness appeared. No recurrence was evident 8 years after operation.

CASE 105 Edye (79) 1922

Male aged 38 years had tumor 2 months. All carotids and internal jugular were ligated. The vagus was injured. No clinical diagnosis was made. Pathological diagnosis carotid tumor. Recovery followed operation but left vocal cord paralysis appeared. No recurrence was evident 6 months after operation.

CASE 106 Feden (4) 1922

Male aged 59 years had tumor 2 years. No ligations were made and no nerves were injured. Clinical diagnosis of carotid tumor was confirmed. Patient recovered without complications.

CASE 107 Müller and Carland (70) 1923

Female aged 35 years had tumor 4 years. The common and external carotid arteries were ligated and no nerves were injured. Clinical diagnosis was tuberculous adenitis. Pathological diagnosis perithelioma. Patient recovered but with a temporary paralysis of one half of the tongue. No recurrence appeared in one year.

CASE 108 Knighton (53) 1923

Male aged 58 years had tumor 15 years. The external carotid was ligated. Clinical diagnosis was tumor of neck (had fainting attacks from pressure on vagus). Pathological diagnosis was non-malignant carotid tumor. Recovery with complete aphonia followed operation. No recurrence was evident in one year.

CASE 109 Boat (12) 1923

Male aged 41 years had tumor 6 months. All carotids and the internal jugular were ligated. No nerves were injured. Clinical diagnosis was extrinsic tumor of larynx with Stokes Adams disease. Pathological diagnosis carcinoma (?) of carotid gland.

Patient died one week after operation of acute edema of the larynx.

CASE 110 Herard and Dunet (8) 1923

Patient had tumor 3 years. The external carotid and the internal jugular were ligated. The vagus was injured. Clinical diagnosis was branchiogenic carcinoma but pathological diagnosis was malignant carotid tumor. Aphasia and hemiplegia (internal carotid thrombosis) developed and death ensued 2 days after operation.

CASE 111 Guthrie (42) 1924

Female 39 years had tumor 3 years. Clinical diagnosis was mixed tumor of parotid but operative diagnosis was adenoma of the carotid gland. Tumor was not removed.

CASE 112 Pinker (9) 1924

Common carotid and internal jugular were ligated. The vagus was injured. No clinical diagnosis was made. Pathological diagnosis was carotid tumor. Recovery.

CASE 113 Stiltmann (9) 1924

Patient had tumor 9 years. No clinical diagnosis was made but pathological diagnosis showed carotid tumor.

CASE 114 Thorn (9) 1924

Patient had tumor 4 years. The common carotid was ligated. No clinical diagnosis was made but the pathological diagnosis was carotid tumor. Death occurred 24 hours after operation of softening of the brain.

CASE 115 Hartung (43) 1924

Male aged 42 years had tumor 4 years. The internal jugular was ligated but no nerves were injured. Clinical diagnosis was malignant tumor of the neck. Pathological diagnosis carotid tumor. Patient recovered without complications.

CASE 116 Royster (79) 1924

Female aged 7 years had tumor several years. All carotids were ligated. No nerves were injured. Clinical diagnosis was tuberculous adenitis (?). Pathological diagnosis was perithelioma. Recovery without complications ensued. No recurrence appeared in 3 years.

CASE 117 Abe (1) 1924

Patient aged 26 years. Clinical diagnosis was egg-sized tumor of neck. Pathological diagnosis tumor of parenchyma.

CASE 118 Jassowicz (47) 1924 Unable to obtain journal

CASE 119 Sullivan and Fraser (94) 1925

Female aged 49 years had tumor 10 years. No ligations were made and no nerves were injured. Clinical diagnosis was cervical adenitis or carotid tumor. Pathological diagnosis perithelioma. Patient recovered and had no recurrence in 13 1/2 years.

CASE 120 Sullivan and Fraser (94) 1925

Male aged 38 years had tumor 8 years. No ligations were made. Clinical diagnosis was carotid tumor or aberrant thyroid. Pathological diagnosis was neuroblastoma of carotid gland. Patient recovered. Contracture of pupil persisted 21 months after operation.

## CASE 121 Sheehan and Rabiner (86) 1925

Female aged 50 years had tumor 2 years. No ligations were made and no nerves were injured. Clinical diagnosis was aneurism of the facial artery. Pathological diagnosis was carotid tumor. Patient recovered and was treated with X rays.

## CASE 122 Maiocchi (4) 1925

Male aged 16 years had tumor 2 years. No ligations were made and no nerves were injured. Clinical diagnosis was not made but the pathological diagnosis was fibro angioma of the carotid gland. Patient recovered but had a temporary paralysis of the cervical sympathetic.

## CASE 123 Labey (4) 1925

Female aged 65 years. The external carotid was ligated but no nerves were injured. No diagnosis was reported. Hemiplegia followed operation and patient died in 3 days.

## CASE 124 Leclerc (4) 1925

Female aged 37 years had tumor 7 years. All carotids were ligated and no nerves were injured. No clinical diagnosis was made. Pathological diagnosis was perithelioma. Patient recovered but suffered from aphonia and dysphagia for 2 years. There was no recurrence.

## CASE 125 Bonikowsky (11) 19 6

Male aged 19 years had tumor 2 years. No ligations were done and no nerves were injured. Clinical diagnosis was cyst or fascial sarcoma. Pathological diagnosis was carotid tumor. Hemiplegia developed 3 days after operation (embolus) but patient recovered.

## CASE 1 6 Aperlo and Rossi (4) 19 6

Male aged 64 years had tumor 9 months. No arteries were ligated and no nerves were injured. Clinical diagnosis was possible carotid tumor and pathological diagnosis paraganglioma (mixed tumor of carotid gland). Patient recovered but there were no complications.

## CASE 127 Holoway (4) 1926

Female aged 35 years. No arteries were ligated. Hemorrhage into the tumor was aspirated. No nerves were injured. No clinical or pathological diagnosis was reported. Recovery.

## CASE 128 Bowen and Miller (13) 1926

Female aged 36 years had tumor 3 years. No arteries were ligated and no nerves were injured. No clinical diagnosis was made but pathological diagnosis showed adenoma of carotid gland. Patient recovered but was hoarse for months.

## CASE 1 9 Traut (96) 1927

Female aged 46 years had tumor 12 years. All carotids were ligated. The vagus was injured. Clinical diagnosis was tuberculous adenitis. Pathological diagnosis is carotid tumor. One day after operation hemiplegia and aphasia were noticed. Death occurred 22 days after operation from bronchopneumonia.

## CASE 130 Duroux and Rollin (28) 1927

Male aged 48 years had tumor 5 months. No ligations were made (this case was curetted out). No nerves were injured. No clinical diagnosis was made

but pathological diagnosis was malignant tumor of the carotid gland. Patient recovered. Death occurred 7 months later from recurrence and general cachexia.

## CASE 131 Floercken (32) 1927

Female aged 34 years had tumor 10 years. The common carotid, external maxillary and internal jugular were ligated.

CASE 132 Fitzgerald (31) 1927 Unable to get journal

## CASE 133 Harvey (44) 1927

Female aged 32 years had tumor 1 year. No vessels were ligated and no nerves were injured. No clinical diagnosis was made but the pathologic diagnosis was benign hemorrhagic cyst of the carotid gland. Patient recovered without complications.

## CASE 134 Bevan and McCarthy 1928

Male aged 39 years had tumor 1½ years. No vessels were ligated and no nerves were injured. The tumor was not removed. Clinical diagnosis was probable tuberculous adenitis. Operative diagnosis was carotid tumor. Patient was treated with X rays.

## POST MORTEM CASES

## 1 Leithoff (9) 1904

Patient had a cherry sized tumor of the neck which pathologically was carotid tumor.

## 2 Oberdorfer (9) 1905

Female aged 58 years. Pathological diagnosis was hamartoma of carotid gland.

## 3 Hedinger (9) 1905

Female aged 62 years. Pathologic diagnosis was carotid tumor.

## 4 Cecer (18) 1906

Male aged 40 years had tumor 4 years. Pathologic diagnosis was angiosarcoma of carotid gland.

## 5 Beitzke (7) 1909

Female aged 56 years. Pathologic diagnosis was struma intercarotica.

## 6 Mezais and Peyron (2) 1910

Adult male. Pathological diagnosis was malignant carotid gland tumor paraganglioma.

## 7 Mezais and Peyron (4) 1911

Pathologic diagnosis was paraganglioma.

## 8 Mezais and Peyron (4) 1911

Pathologic diagnosis was carotid tumor.

## 9 Sapegno (81) 1913

Female aged 64 years had tumor 1 year. Patient died of bronchopneumonia while in the hospital awaiting operation. Pathologic diagnosis was carotid tumor.

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PATHOLOGICAL LESIONS OF THE GALL BLADDER<sup>1</sup>

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**T**HE gall bladder because of its accessibility and the frequency with which it is removed readily affords opportunity for the grouping and the correlation of clinical and pathological data.

I have prepared a simple grouping of diseases of the gall bladder based chiefly on the gross examination of 4,575 specimens removed at operation. Microscopic examinations were made of about 50 of each of the larger groups and of all of the smaller groups. Twenty-five to 50 histories of each group were studied and comparisons made.

One specimen may show more than one type of pathological change. I have, therefore, grouped these specimens in sequence according to the amount of pathological change shown. The grouping is as follows: (1) chronic catarrhal cholecystitis, (2) strawberry gall bladder or "cholesterosis", (3) chronic fibrous cholecystitis, (4) subacute and acute cholecystitis, (5) empyema of the gall bladder, (6) gangrene of the gall bladder, (7) hydrops of the gall bladder, (8) papilloma of the gall bladder, (9) adenoma of the gall bladder and (10) malignancy of the gall bladder (tabulation).

## CHRONIC CATARRHAL CHOLECYSTITIS

In this group are included gall bladders showing only slight pathological change (Fig. 1) such as slight change in color and thickening of the walls. It is this type of gall bladder which is frequently removed not so much because of gross change in the organ itself as because of a definite history of cholelithiasis and of associated conditions such as a round edged liver, a surrounding area of hepatitis, or the presence of a sentinel lymph node as stressed by C. H. Mayo. Microscopic examination of this type of gall bladder reveals varying degrees of edema and congestion of the villi and lymphocytic infiltration.

In the 2,051 cases (44.8 per cent) in this group stones were present in 1,250 (61 per

cent) and absent in 801 (39 per cent). In 481 of the 801 specimens in which stones were not found, there was slight thickening and change in color. Of the 1,250 specimens with stones 436 showed only minimal gross evidence of disease. It is possible as Moynihan (1923) and Judd (1925) have stated that this type of gall bladder assumes a normal appearance between attacks not unlike that of the 'interval appendix'. This is substantiated by the frequent occurrence of stones in an otherwise normal appearing gall bladder. The histories of 50 patients were studied to determine the clinical manifestations. The symptoms were those of gastric disturbance. The chief complaints were gastric distress, nausea, vomiting, belching, regurgitation, flatulence, constipation and varying degrees of pain, the severity of which was evidently dependent on the amount of infection or the presence of calculi. The average age of the patients was 44 years of the youngest 27 and of the oldest 67. Sixty-one per cent were women and 39 per cent were men. On examination tenderness was elicited in the right upper quadrant in 74 per cent. The average weight was 150 pounds. The gastric contents of 32 patients showed an average total acidity of 52 and an average free hydrochloric acid value of 32 in terms of tenth normal sodium hydroxide. Achlorhydria occurred in 3 cases.

## 'STRAWBERRY GALL BLADDER' OR CHOLESTEROISIS

Strawberry gall bladder or cholesterosis is a condition in which lipid deposits are found embedded in the epithelial cells or stroma thus giving the characteristic strawberry appearance (Fig. 2). Moynihan (1909) described this condition but at that time thought it was due to fine granules of calculus embedded in the mucosa. MacCarty (1910) described the condition in detail and named it strawberry gall bladder. He first believed it to be secondary to sloughing of the superficial epithelial cells and bile stained stroma but in

<sup>1</sup>Abridgment of thesis submitted to the Faculty of the Graduate School of the University of Minnesota in partial fulfillment of the degree of Master of Science in Surgery, 1923. Work done in Section of Surgical Pathology, The Mayo Clinic. Submitted for publication June 10, 1929.



Fig 1 Chronic catarrhal cholecystitis slight thickening of the walls is shown

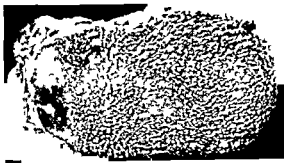


Fig 2 Strawberry gall bladder or cholesterosis

1919 he described it as being due to a lipid deposit within the swollen connective tissue which lies just beneath the epithelium of the villi. Boyd (1923) showed that the lipid was a cholesterol ester and Mentzer (1925) applied the name *cholesterosis* to the condition. Various experiments have been carried out to determine whether the deposit of cholesterol is a result of excretory or secretory function of the gall bladder and from these it appears obviously due to a secretory function. MacCarty (1919) reported that 18 per cent of 4,998 surgically removed gall bladders showed deposits of cholesterol. Mentzer (1926) in a series of 612 necropsies on adults reported cholesterosis in 21 per cent.

The incidence in my series is about the same as that in the series which Mentzer reported. There were 1,094 cases (23 per cent). Of these, 552 (50 per cent) were associated with stones. In only 465 (43 per cent) were the walls definitely thickened. Papillomata were present in 164 (14 per cent).

The microscopic picture in cholesterosis has been described by MacCarty (1919), Corkery (1922) and Boyd (1933). The lipid is usually deposited as fine granules in the cells, lumen and acini just under the base of the epithelial cells and in the cells of the submucosa (Fig 3). Occasionally the lipid occurs in masses. Varying grades of round cell infiltration also occur.

I studied the histories of 50 patients with this type of cholestatic disease but I could find nothing which might distinguish this type from chronic catarrhal cholecystitis. Of these

50 patients 69 per cent were women and 31 per cent were men. The average duration of symptoms was 6 years. The average weight was 153 pounds. Some of these patients, who were of normal weight at the time of examination had been definitely overweight. Sixteen patients had had test meals. The average total acidity was 54 and the average free hydrochloric acid value was 33, two had achlorhydria.

#### CHRONIC FIBROUS CHOLECYSTITIS

Chronic fibrous cholecystitis is a condition of the gall bladder in which there is marked proliferation of fibrous tissue as a result of a long continued inflammatory process. In this group, the changes have progressed beyond the stages of chronic catarrh and cholesterosis. There is proliferation of the connective tissue of the walls, the surface is contracted, the

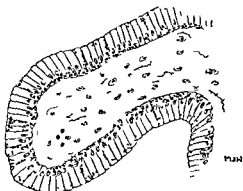


Fig 3 Deposits of cholesterol in epithelial cells and stroma



Fig. 4 Chronic cholecystitis ridges of scar tissue may be seen

walls are thickened with ridges of scar tissue and there is loss of elasticity (Fig 4) The mucosa is in part or wholly replaced by connective tissue, and there is lymphocytic infiltration

There were 329 cases (7 per cent) of this type in the series, in 294 (89 per cent) of these, stones were present The histories of 25 patients were studied The average age was 43 years, there were three times as many women as men the average duration of symptoms was 9 years, and the average weight was 144 pounds There was nothing unusual or characteristic in the clinical histories except that the symptoms possibly were more severe and of longer duration than in the former types About 30 per cent had a history of jaundice and 10 per cent had chills and fever Thirteen patients who had had gastric analysis had an average total gastric acidity of 50 and an average free hydrochloric acid value of 32 Achlorhydria was not present in this group



Fig. 6 Single papilloma in a chronic catarrhal cholecystitis



Fig. 5 Hydrops of the gall bladder stone impacted in cystic duct

#### SUBACUTE AND ACUTE CHOLECYSTITIS

In subacute and acute cholecystitis there is active inflammatory reaction as a result of acute infection Such gall bladders show injection and oedema of the walls with or without purulent changes, and on microscopic examination leucocytic infiltration is seen The streptococcus, as shown by Rosenow, is the most common offending organism

There were 319 specimens (69 per cent) of this type in the series of which 308 (96 per cent) contained stones Forty six were considered to be acutely inflamed and 273 subacutely inflamed About half of these gall bladders also showed evidence of marked chronic fibrous cholecystitis as manifested by fibrosis and marked thickening of the walls The histories of 25 patients were studied The average age was 47 years Chills and fever occurred in 20 per cent and attacks of gall bladder colic in 75 per cent At the time of examination of these patients, the gall bladder was palpable in about a third of them The temperature on admission varied from only



Fig. 7 Numerous papillomata in chronic catarrhal cholecystitis



Fig 8 Adenoma of the gall bladder branching acini are shown



Fig 9 Carcinoma acini filled with malignant cells in carcinoma simplex



Fig 10 Adenocarcinoma with mucoid production

99.2 degrees to 100 degrees. The highest leucocyte count was 17,000 in only two other cases was it more than 10,000. Marked tenderness was elicited in practically all cases. The gastric content was not examined.

#### EMPHYEMA OF THE GALL BLADDER

Empyema of the gall bladder is the result of an infection superimposed on obstruction of the cystic duct. The pathological picture is the same as that which exists in other organs in which pus forms with thickened walls and diffuse inflammatory reaction.

There were 109 specimens (2.3 per cent) of this type in the series. Stones were present in 103 cases (96 per cent).

The histories of 25 patients were studied. The average age was 50 years and the average weight was 150 pounds. Clinically these patients could be classified in two groups. In one group, comprising about 90 per cent, there was a long history of repeated colic and little if any, suggestion of any purulent or inflammatory process. It might be expected that the chronic empyema type would fall in this group. In the smaller group there was a relatively short history of colic or soreness, the purulent process was evidently coincident with the first attack, namely acute empyema. As Moynihan (1928) stated "The clinical conditions associated with empyema of the gall bladder vary greatly in severity and are

in direct proportion to the intensity of the infection, in the more chronic forms the symptoms may be a little more acute than in hydrops, while in the more acute they are so grave that a fatal result may occur within a few days all depending upon the severity of the infection." The temperature of the patients in this group at the time of examination varied from normal to 100 degrees, only 4 patients had a temperature of 100 degrees F or slightly above. The average leucocyte count was 9,000 in each cubic millimeter of blood with 11,000 the upper limit. The gall bladder was palpable in six cases (24 per cent). The gastric content was not examined.

#### GANGRENE OF THE GALL BLADDER

Gangrene of the gall bladder may be produced by the toxins of the infective agent, or in some cases may be due to occlusion of the cystic artery from embolism, thrombosis, or the pressure of a stone. In this type acute rupture may occur either into the duodenum, the liver or the general peritoneal cavity. The frequency with which the rupture is noted varies greatly in the various larger clinics and hospitals. At The Mayo Clinic according to this series it was noted in about one in every thousand cases in which cholecystectomy was performed.

In the series there were 60 cases (1.3 per cent) of gangrene, and stones were present in





Fig. 11 Squamous cell epithelioma of the gall bladder



Fig. 12 Section of malignant papilloma



Fig. 13 Lymphosarcoma of the gall bladder

58 (96 per cent). The histories of 25 patients were studied. The average age was 45 years, 50 per cent were men. The average weight was 168 pounds. The patients were all distinctly ill, much more so than any with the preceding types of cholecystic disease and marked tenderness was noted in the right upper quadrant in all. About 20 per cent had chills and fever. The leucocyte count of 5 patients was more than 10,000 and of one it was 15,000. The temperatures, which varied from 98.6 degrees to 101 degrees, were above normal in only half of the cases. A mass was palpable in 30 per cent of the cases.

#### HYDROPS OF THE GALL BLADDER

Hydrops of the gall bladder (Fig. 5) is produced by obstruction of the cystic duct either from a stone becoming lodged in the duct or rarely by inflammatory or other mechanical constriction at the neck of the gall bladder. The gall bladder occasionally becomes enormously distended and has been reported as being so large as to be mistaken for ovarian cyst. The incidence of hydrops reported by MacCarty in 1910 was 20 per cent. In 1919, 2.7 per cent; the difference is undoubtedly due to earlier removal of gall bladders in later years.

In the series there were 158 cases of hydrops (3.4 per cent) in 152 (96 per cent) stones were present. In the 6 remaining cases the hydrops might be considered secondary to inflamma-

tory or other mechanical constriction. The histories of 50 of the patients were studied. The average age was 40 years, the average weight was 167 pounds, and 80 per cent gave a history of gall stone colic. The patients did not appear so ill as those suffering from inflammatory or gangrenous cholecystic disease and tenderness on palpation was much less. A mass was palpable in only 18 per cent of the cases. In 20 cases the gastric content was examined. The average total acids were 3.2 and the average free hydrochloric acid 3.1; achlorhydria occurred in 2 cases.

#### PAPILLOMA OF THE GALL BLADDER

In these cases the cells cover finger-like processes or ridges of stroma. The papillomata usually occur singly (Fig. 6) but occasionally the entire surface of the gall bladder is literally studded with bunches of these finger-like processes (Fig. 7). The condition is primarily hypertrophy of one or more villi. They are light yellow due to a deposit of cholesterol in the stroma. Microscopic sections in this series, stained with scarlet red, all showed a deposit of lipid substance in the submucous stroma. The tumors vary in size from 1 to 4 millimeters. A single papilloma is frequently very small and since it is extremely friable is undoubtedly often overlooked.

In 417 of this series (9 per cent) one or more papillomata were observed in 129 of these (30

## SUMMARY OF DATA IN 4 575 GALL BLADDERS REMOVED AT OPERATION

	With stones		Without stones		Total	
	Cases	Per cent	Cases	Per cent	Cases	Per cent
Chronic catarrhal cholecystitis	1250	61	801	39	2051	44.8
Strawberry gall bladder or cholesterosis	552	50	542	50	1094	23.8
Chronic fibrous cholecystitis	204	89	35	11	239	7.1
Acute and subacute cholecystitis	303	96	11	4	319	6.9
Empyema of the gall bladder	105	96	4	4	109	2.3
Gangrene of the gall bladder	58	96	2	4	60	1.3
Hydrops of the gall bladder	152	96	6	4	158	3.4
Papilloma of the gall bladder	120	30	288	70	417	9.1
Adenoma of the gall bladder	6	25	18	75	24	0.5
Malignancy of the gall bladder	14	100			14	0.3

per cent) there were stones. The exact relationship between benign and malignant papilloma is problematic. Malignant changes occurring in papillomata have been reported, but evidence of malignant change was not present in any of these specimens. In a survey, however, of the various malignant conditions of the gall bladder, several papillary carcinomata were found.

The histories of 100 patients were studied. The average age was 44 years, the youngest patient was aged 21 years, and the oldest 68 years. The average weight was 140 pounds. The symptoms were not characteristic, but were simply those of cholecystitis in general, with or without stones. The gastric content was examined in 58 cases, the average total acids were 48, and the average free hydrochloric acid was 37. Achlorhydria occurred in 7 cases.

## ADENOMA OF THE GALL BLADDER

In MacCarty's report in 1919, on about 5,000 gall bladders, there was only one adenoma. In fact, only a few adenomata are reported in the literature.

In this series of 4,575 gall bladders 24 adenomata were noted. The tumor was situated in the fundus of the gall bladder, an interesting fact inasmuch as normally glandular tissue is not present in the fundus, but its presence in some cases may explain in part the occurrence of adenocarcinoma in that situation. The average size of the adenomata was 1 centimeter, the smallest was 4 millimeters and the largest, 3 centimeters in diameter. Only six of the specimens contained calculi. On microscopic examination the adenomata were found to contain acini of columnar epithelium sur-

rounded by connective tissue stroma, without evidence of malignant degeneration (Fig 8). The histories of all of the patients in this group were studied. The average age was 46 years, the youngest patient was aged 28 years, and the oldest 62. The average weight was 133 pounds. The symptoms were those of cholecystic disease.

## MALIGNANT LESIONS OF THE GALL BLADDER

The incidence of malignant lesions of the gall bladder is commonly given as ranging from 2 to 4 per cent. W. J. Mayo noted an incidence of malignancy of about 5 per cent. The incidence of malignancy in MacCarty's series (1919) was 0.5 per cent.

In this series there were 14 cases (0.3 per cent) of malignant lesions of the gall bladder. The types of malignancy of the gall bladder may be grouped as (1) carcinoma simplex (Fig 9), (2) adenocarcinoma (Fig 10), (3) squamous cell epithelioma (Fig 11), (4) papillary carcinoma (Fig 12), and (5) sarcoma (Fig 13). Carcinoma simplex and adenocarcinoma are the most common. These show branching acini of cylindrical cells, some of which surround a central lumen, others completely obliterating the lumen. Eleven of the fourteen lesions were either carcinoma simplex or adenocarcinoma. There were two cases of squamous cell epithelioma containing prickly cells, intercellular fibers, and horny cell nests. The condition is rare and is due to a process of metaplasia as a result of long continued irritation. Such change, when it does occur, however, is almost always associated with malignancy. There was one case of lymphosarcoma of the gall bladder. This condition is exceedingly rare. Goldstein (1921) was able to

find only 16 cases in the literature. Calculi were found to be a constant factor in association with malignancy of the gall bladder. In Deaver's experience stones occurred in 87 per cent of cases, and usually higher percentages are reported. All of the specimens in the group reported were associated with stones.

The histories of all of the patients in this group were studied, as well as those of about 50 other patients. The average age was 55 years. Usually there was a long history of repeated colic. Clinically, the cases could be grouped under three heads. In the first group, about 22 per cent, symptoms were present of an apparently harmless type of cholecystic disease, namely, flatulence, intolerance to food, belching, and vague pain or tenderness, without loss of weight or appetite. In the second group, 70 per cent, there was a long history of repeated attacks of colic, followed by a history of from 1 to 3 months in which sudden change was characterized by continuous severe pain, anorexia, and progressive loss of weight. In the third group the histories were relatively short with reference to colic, 1 to 3 months, in which the malignant phase of anorexia, loss of appetite, loss of weight, and pain occurred coincidentally with the first symptoms of cholecystic disease. The patients in the two last groups lost on an average of 30 pounds in less than 6 months. In half of the cases a mass was palpated, in three there was jaundice. The blood picture was not associated with anemia in any case. The average hemoglobin was 73 per cent, and the hemoglobin was not below 60 per cent in any case. The average total gastric acids were 39, and the average free hydrochloric acid was 31. In two cases achlorhydria was present.

#### SUMMARY

A simplified grouping of lesions of the gall bladder has been prepared in a series of 4575 gall bladders, and the clinical manifestations in each group have been studied for comparison. There are no characteristic symptoms or clinical data to differentiate the apparently earlier types of cholecystic disease, in the later stages, however, certain characteristic data are present.

The clinical features of chronic catarrhal

cholecystitis and strawberry gall bladder, or cholesterosis, were identical. The occurrence of stones in a fairly high percentage of gall bladders showing minimal pathological change further substantiates the theory that gall bladders may assume a normal appearance between attacks.

Chronic fibrous cholecystitis showed a higher incidence of gall stone colic, jaundice, chills, and fever than the groups of chronic catarrhal cholecystitis and strawberry gall bladder, or cholesterosis. Stones were present in 89 per cent of the cases in this group.

Acute and subacute cholecystitis may occur without appreciable increase in temperature or leucocytosis. Gall stones occurred in 96 per cent of the cases.

The symptoms of empyema of the gall bladder vary greatly. The chronic form usually is not accompanied by any grave manifestations, the acute form not infrequently is fulminating in character. Stones occurred in 96 per cent of the cases.

Gangrene of the gall bladder is associated with marked clinical manifestations. There is marked tenderness, and the temperature and leucocyte count are higher than in the acute forms. Stones occurred in 90 per cent.

Hydrops of the gall bladder was associated with stone lodged in the cystic duct in 96 per cent of cases. A mass was palpable in 20 per cent. The patients were not nearly so ill as patients suffering from the acute empyema or gangrenous types of cholecystic disease.

Papillomata occur more frequently than the reported frequency. The single papilloma is friable and easily overlooked. The relation between papilloma and malignancy is problematic.

Adenomata always occur in the fundus. Normally glandular tissue is not present in the fundus of the gall bladder, this may, however, explain the frequent occurrence of adenocarcinoma in this situation.

The common types of malignant lesions of the gall bladder are carcinoma simplex, adenocarcinoma, squamous cell epithelioma, papillary carcinoma, and sarcoma. Stones are a constant factor. Clinically malignant conditions of the gall bladder may be classified in two groups. In the first group the history is of

mild cholecyctic disease, in the second group, of long duration of colic with a short terminal phase of loss of appetite, loss of weight, and constant pain, and in the third group, a short history of colic with a coincident malignant phase of loss of weight, anorexia, and pain

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## EXPERIMENTAL PERITONITIS - II THE EFFECT OF HYPERTONIC DEXTROSE SOLUTION UPON EXPERIMENTAL DIFFUSE PERITONITIS<sup>1</sup>

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**I**N a preliminary report of experimental work, presented two years ago, (1) we demonstrated that—

1 The transudate produced by the intra peritoneal injection of hypertonic dextrose solution enabled maintenance of the patency of rubber tube drains introduced within the peritoneum

2 Adhesions between inflamed loops of bowel could be prevented by means of the mechanical isolation produced by the transudate and the absence of fibrin resulting from the great dilution of the normal serous exudate

3 A transudate of considerable volume could be maintained in the peritoneum of the experimental animal without obvious harm

According to Kuhn, who has written extensively on the use of intraperitoneal hypertonic dextrose solution, "sugar stops the toxin formation of all bacteria in the peritoneal cavity and replaces it by the fermentative herbivorous metabolism, which results in harmless acid products instead of injurious alkaline ones. It favors isolation, irrigation and fibrinolysis." Kuhn reports that with the use of dextrose, "cases that seemed doomed, have been saved." Reiche, in the most extensive research published in this subject, verified Kuhn's observation of delayed absorption from the peritoneum in the presence of dextrose. Narat produced what he considered a satisfactory lethal standard in 20 rabbits and reported recovery in 14 of 18 rabbits after intraperitoneal injection of 20 per cent dextrose solution. Claiborne, Haber and other investigators used glycerine collodion, camphor, zinc paste, and olive oil to lessen peritoneal absorption.

There are two mechanisms in wide spread peritonitis, either one of which may produce death—obstruction through ileus and toxic absorption from the inflamed peritoneal surface and the contained exudate

In the absence of ileus we may assume that the toxemia results from the absorption from the peritoneum of bacteria and their products, and that the resorption of the exudate itself plays a powerful, if not leading, rôle in the production of this toxemia. In a like manner, it is logical to assume that any process that will (1) delay the rate of absorption and (2) remove the larger percentage of the toxic exudate, will be a factor in lowering the mortality rate. Physicians are familiar with conditions that slow absorption. In addition to the substances mentioned, cold, diminution of peristalsis and fibrin also slow the rate of absorption. David called attention to the inhibitory influence of fibrin upon the absorption of diphtheria toxin and colon bacilli. It is conceivable that with the source of a given peritonitis under control, if it were possible to extend or slow by several days the resorption of a vast amount of toxic exudate, recovery might replace an otherwise fatal issue.

Exudation and absorption play the outstanding rôles in peritonitis. The entire mechanism of the peritoneum is concerned with the attempt to localize and limit the extent of serosa involved. Fibrin plays the major rôle in this mechanism. By its capacity for producing adhesions and encapsulation fibrin limits or slows the spread of suppuration. By its close adhesion to inflamed surfaces, it delays absorption.

The diffusion of an inflammatory process in the peritoneum is dependent on or follows a deficiency in fibrin formation. The abundant, thin, seropurulent exudate of generalized peritonitis is familiar. In our experimental work we have noticed a striking inverse quantitative relationship between fibrin and virulence. Animals which died in 2 days or less showed no fibrin or at best scant traces. It is obvious, therefore, that any procedure which interferes with or prevents fibrin formation, would be a dangerous one.

<sup>1</sup>Read before the Surgical Society May 3, 1926. From the Laboratory of Surgical Research and the Department of Surgery Northwestern University Medical School.

In our preliminary experimental work with the normal peritoneum we found it possible to exhaust or at least markedly diminish the absorptive capacity of the peritoneum. A single injection of 200 or 300 cubic centimeters of a 20 per cent dextrose solution that routinely produced a transudate approximately double that amount within the first 12 hours, almost always left the peritoneum fluid free at the end of 24 hours. We discovered, however, that when such a transudate is maintained for 5 or 6 days, almost an equal amount of time was required for complete absorption of the transudate. A number of observers have discussed the apparent slowing in the absorption rate in cases of wide spread peritonitis of several days' duration, as contrasted with the rate of absorption at the beginning of the disease. There can, of course, be little doubt that the rate of absorption must be materially delayed in the interval between the injection of a hypertonic solution and the establishment of an isotonic balance.

This then we considered our problem. To add to the exudate a transudate produced by hypertonic dextrose solution with the idea that (1) absorption from the peritoneum will be slowed by the transudation and dilution of the exudate, and that in addition, removal of larger amounts of this exudate than hitherto have been possible, could be accomplished by drainage. Since in widely disseminated peritonitis there is a fibrin failure, the addition of a factor capable still further of inhibiting fibrin did not seem to us to be detrimental. We did not engage the problem of peritoneal absorption—one that is as yet by no means settled—and we shall not take up the discussion of the mechanism of absorption of crystalloids, colloids, and particulate matter, or of the complex nature of the exudate itself.

The first phase of this experimental work was concerned with obtaining a satisfactory lethal standard. In the countless papers that have been published on experimental peritonitis the majority of experiments have been conducted with bacterial cultures or pus from other sources. We sought a peritonitis that duplicated in its etiology and clinical course, as much as possible, the peritonitis of man, with the following characteristics

- 1 The animal's own intestinal tract should be the source of the peritonitis because of discrepancies that would be introduced by the use of cultures

- 2 The peritonitis should be diffuse to generalized. A sharp distinction must be made between a large, localized abscess and a generalized peritonitis

- 3 The peritonitis must as nearly as possible be lethal, but not destroy the animal in 1 or 2 days, as it is utterly impossible to influence in any way an infection of such overwhelming virulence

The procedure used was as follows. A segment of bowel of varying size was resected but left intact to its mesentery to insure its viability. Both ends were left open and henceforth this segment will be referred to as the "open loop." An end to end anastomosis was made around this loop and the opening in the mesentery closed. The omentum was wrapped about the suture line of the anastomosis and the bowel with the loop returned to the abdomen and a complete closure made. Autopsies were done as soon as possible after death and observations made on the following points: (1) the extent of the lesion, (2) the character and quantity of the exudate, (3) the bacteriology, and (4) the condition of the anastomosis.

#### EXPERIMENTAL WORK

*Group I* In a series of 9 dogs a 6 inch open loop of the lower jejunum or upper ileum was used. There was one anesthetic death in this group, leaving 8 for consideration. Four dogs (50 per cent) of this group died of generalized peritonitis, 3 of them in 3 days, 1 at 12 days. One died at 107 days of multiple abscesses, one in 95 days of pneumonia with a low grade peritonitis, and one of pneumonia at 110 days. One died in 7 days of intestinal obstruction due to kinking.

*Group II* In a series of 6 dogs an open loop of the lower jejunum 12 inches in length was used. There were 2 deaths from diffuse peritonitis, 1 at 1 day due to a leaky anastomosis, 1 at 7 days. The remaining dogs lived 34, 46, 76, and 90 days. Three died of pneumonia and 1 died of pneumonia and a peritoneal abscess.

*Group III* In a series of 13 dogs, a 14 inch open loop of lower jejunum was used. There

was one anæsthetic death, twelve animals being left for consideration. There were 8 deaths from generalized peritonitis, of which one was due to leaky anastomosis. Excluding the latter, the average duration of the disease was 5 days. Three dogs were killed at 30, 50, and 61 days, respectively. In 2, the peritoneum was clean. In 1 there was a considerable quantity of mucilaginous material. One died at 81 days of multiple peritoneal abscesses.

*Group IV* In a series of 8 dogs the tip of the appendix was amputated and left open and the abdomen was closed. There were 3 deaths from generalized peritonitis, 2 in 1 day, 1 in 4 days. One died from a large localized abscess in 3 days. Two died of a local abscess in 10 and 66 days. At biopsy on the thirtieth day, one was found to have a localized abscess.

*Group V* In a series of 13 dogs, a larger opening in the appendix was made than that in Group IV, in order to provide more rapid and wide spread soiling. The animals were re-opened at the end of 22 to 26 hours and the opening in the appendix was closed by suture. There was one anæsthetic death. There were 5 deaths of generalized peritonitis, 2 in 1 day, 3 in 2 days. Biopsies made on 4 at 8, 10, 12, and 14 days disclosed localized abscesses. The biopsy on 1 at 100 days showed a mass of dense adhesions.

*Group VI* In a series of 7 dogs the appendix was ligated with its mesentery after the manner suggested by Costain. Two dogs died of generalized peritonitis at 2 days. One died on the sixth day of a large localized abscess. At biopsy one on the eighth day showed a moderate sized abscess. Biopsies on 3 others, on the fourteenth, eighteenth and twenty third days, showed the peritoneum to be clean.

*Group VII* In a series of 7 dogs an open loop of colon 15 inches in length was used. There were 2 accidental deaths in this series, 1 from anæsthesia and 1 one from a leaky anastomosis. The remaining 5 died of a severe generalized peritonitis, 2 in 1 day, 1 at 2 days, 1 at 3, and 1 at 5 days.

*Group VIII* In a series of 34 dogs an open loop of mid ileum 20 inches in length was used. There was 1 anæsthetic death and 2 deaths from leaky anastomosis. Of the re-

maining 31, there were 28 deaths from generalized peritonitis, 1 death from a large, localized abscess. One dog was used through error by one of the investigators for other work, and no autopsy was obtained. One animal survived and a biopsy was done 100 days later. There was still a low grade, diffuse peritonitis, with a fibrinopurulent exudate, and many diplococci were found in smears. The average duration of the disease was 4 days. 2 animals died in 1 day, 3 lived 6 days, 4 lived 7 days, 1 lived 9 days and the remainder died on the second, third, fourth, and fifth days. This lesion, we decided was the control that we were seeking.

#### DISCUSSION

The difficulties of producing a satisfactory lethal standard of generalized peritonitis are demonstrated in this series of 103 dogs. The peritoneum of the dog will tolerate an astounding degree of contamination from intestinal contents, without producing death. We failed to get a mortality above 75 per cent, in cases in which a 14 inch loop of lower jejunum was used. The use of an open loop of colon, though a short one, produced so rapidly fatal a lesion as to make any form of experimental therapy impossible.

The greater frequency of local peritonitis following lesions of the appendix is worthy of mention. We must take issue with Costain who stated that ligation of the appendix and meso appendix invariably produced death from diffuse septic peritonitis in about 2 days. In a total of 28 animals, in which the appendix was used, only 10 developed generalized peritonitis and died. Four more died of local peritonitis and 5 in which the lesion did not prove fatal, were found at biopsy to have local peritonitis. Lehman and Copher found this same discrepancy in Costain's controls.

The use of a 20 inch open loop of ileum gave a satisfactory lethal standard, the average duration of the disease being 4 days, and the mortality from generalized peritonitis 90.3 per cent. The pathological findings were quite uniform. They consisted of a peritonitis that involved practically the entire abdomen. The radiation was always quite obviously from the open loop, one end of which was almost invariably plugged by omentum. Encapsulated or

partially encapsulated abscesses were frequent in the vicinity of the open ends of the loop. The amount of fibrin in evidence was usually inversely proportional to the duration of the disease. In the most rapidly fatal form observed in animals dying in 1 and 2 days, fibrin was absent.

The bacteriology of these animals presented some points worthy of mention. The colon group was of course omnipresent, and the staphylococcus was frequently encountered. The streptococcus was absent, or present in small numbers, in animals that survived the mild diffuse infections, or in those developing encapsulated lesions. In our rapidly fatal cases, the streptococcus was present in large numbers, or predominated. Two features characterized the latter cases, abundant, thin exudate and subserous petechial hemorrhages. It is interesting to note that an animal harbored many staphylococci and a fibrinopurulent exudate for a period of over 3 months.

#### INTRAPERITONEAL DEXTROSE

In a series of 37 dogs, the usual 20 inch open loop of ileum was made and the abdomen closed. Twenty four hours later, when a diffuse spreading peritonitis was assured, 20 per cent dextrose solution was injected into the peritoneum hypodermically. About 50 per cent of the maximum safe dose of dextrose was given at the first injection. It has been demonstrated that the normal animal will tolerate an intraperitoneal injection equivalent to approximately 1 per cent of its body weight in dextrose.

The animal was given repeated injections of approximately the same dosage at intervals of 12 hours. In the first 10 animals we did not give a hypodermoclysis of normal salt solution. These dogs obviously suffered from dehydration—a symptom that was not noticed in the control animals which were given no dextrose. It is far more difficult to control dehydration in a dog than in man. In the next 17 animals normal salt solution was injected subcutaneously at the time that the dextrose solution was given intraperitoneally in varying amounts up to twice the volume of the dextrose solution given. The average

length of life after operation of the first 10 animals was 17.5 days. Of the next 17, it was 22 days. One animal survived after injections over a period of 5 days. Biopsy on the seventy-seventh day revealed the abdomen partially filled with a mucilaginous material, relatively free from adhesions, excepting those between the omentum and the open loop. Smear showed bacilli and diplococci present. The amount of exudate present at autopsy in this series of 37 animals was 50 per cent to 100 per cent greater than in the control animals and showed a thinning in consistency that would be expected from the increase in peritoneal secretion produced by the dextrose solution. In these animals there was a definite diminution in the amount of encapsulation about the open loop.

In the next 10 animals, following the usual loop resection, a soft rubber tube drain was sutured into the peritoneum and dextrose injected hypodermically through the right hypochondrium and through the tube, which was in the lower abdomen. We attempted to maintain the patency of the tube and communication between the latter and the free peritoneal cavity, injections being given, as in the previous series every 12 hours. One animal survived and is still alive. The remaining 9 died of generalized peritonitis, 2 in 1 day, 4 in 2 days, 1 in 3 days, and 2 in 4 days—an average duration of  $2\frac{1}{4}$  days. Two of the animals drained in such large amounts as to indicate that the drain was not encapsulated. In the remaining 7, encapsulation occurred in spite of a copious exudate and wide distribution of the dextrose solution.

The dextrose solution did not effect the healing of the suture line of the end to end anastomosis. We have previously had occasion to note that such a suture line will remain intact and heal normally in the presence of a fibrin free transudate. It would seem, therefore that fibrin is not essential to the safety of a peritoneal suture line nor its future healing, but at autopsy it was apparent in this series of animals that a more rapid spread of the peritonitis was due to the lavage of the transudate, and this resulted in death in an average of 2 days instead of in 4, as occurred in the controls.



## COMMENT

Dextrose solution injected into the abdomen in the presence of a diffuse peritonitis during the period of spread, failed not only favorably to influence the mortality, but shortened the duration of life by 50 per cent. This action is probably due to a speeding up of the diffusion of the infection over a wide area of the peritoneal surface. In his experimental study, one year ago, David suggested this point. The absorptive power of the peritoneum remained good through the second and third days of the disease, as was shown by the disappearance of the sugar from the peritoneal exudate at autopsy, but in those animals surviving 4 or 5 days, the sugar test was positive, ranging from 2 per cent to 4 per cent. The temporary delay in absorption, which we should expect to occur during the period when an osmotic balance between the hypertonic peritoneal exudate and the blood serum was occurring, was not sufficient to lower the mortality or even ameliorate the course of the disease. We may assume by analogy that the above facts would obtain in human cases namely, that the temporary slowing of the absorptive capacity of the peritoneum caused by hypertonic dextrose solution would not modify the course of the disease.

The capacity of the peritoneum for encapsulation which is present in the normal membrane and in moderate grades of infection is absent, or markedly diminished in the presence of virulent infection. Such a condition is, as we have stated, a fibrin failure, the result of the excessive dilution, produced by the abundant exudate that characterizes such rapidly spreading infections. There is, however, a striking paradox in the latter situation. In such a peritonitis, with no fibrin in evidence one would assume the capacity of the peritoneum, for encapsulation of a rubber drain would be no greater than its capacity of encapsulation of the source of infection. Yet the omentum will more effectively plug a benign rubber drain than a bowel perforation or the open end of a contaminating loop, and the vicinity of the drain will quite likely show the only evidence of fibrin in the abdomen. This should re-emphasize the futility of any type of drainage in peritonitis.

This brings us to a consideration of a possible relationship between the exudate and paralytic ileus. In the few cases in man in which we have opened the abdomen because of paralytic ileus, we have been impressed by the scantiness, or even absence, of a fluid exudate. The dog does not die of paralytic ileus, we have not observed a single instance of ileus in more than 200 animals with peritonitis. But the dog's peritoneum produces an exudate proportionately greater in quantity than does the peritoneum in the human. In the abundant exudate present in practically every fatal case, the intestinal tract is literally bathed in exudate. It seemed to us that the mechanical isolation of the contiguous loops of bowel caused by the very abundance of the exudate is the prime factor in preventing ileus. In such cases we believe that the exudate acts as a mechanical isolator of the intestinal loops.

It is known that the intra peritoneal introduction of hypertonic solutions stimulates peristalsis. Hypertonic dextrose solution will produce such a mechanical isolation of distended loops very satisfactorily. It is still to be determined whether or not in such a procedure we have a safe and satisfactory means of relieving intractable ileus with low grade, but diffuse, peritoneal infection.

In dealing with human peritonitis we frequently encounter a diagnostic problem that can be settled only at autopsy, this is the extent of involvement of the peritoneum. The clinical signs by which we diagnose the disease will usually not serve to define its extent. Experimentally we have demonstrated to our own satisfaction that the animal with a rather wide spread, diffuse peritonitis may live. The animal with complete or nearly complete, involvement nearly always dies. It takes, however a surprisingly long time to involve all of the peritoneum even in the presence of rapid, wide spread soiling where localization or encapsulation does not occur and where even traces of fibrin are not observed. In such animals, who uniformly died at the end of 4 days of a generalized peritonitis, at the end of 24 hours there was present a diffuse lesion that did not involve in excess of one third of the peritoneal surface. Even the most mobile of the viscera, the small bowel, is only partially

involved at this time, yet in some instances it took 7 or 8 days for the lesion to spread to the diaphragm and to the pelvis

How then can we reconcile the results of this experimental work with the several reports that describe in glowing terms the results of hypertonic dextrose solution in severe human peritonitis?

It will probably never be possible to describe a lethal standard in the human. It is notoriously difficult to judge the virulence of the disease or its extent by the clinical picture except in moribund cases without wide spread exploration. It is possible to introduce dextrose, as has been done, through a small incision into a part of the peritoneum not actively involved in a septic process. If the primary focus is already encapsulated, the fibrinous exudate responsible for this encapsulation will be unaffected by the transudate in the free peritoneum. Kuhn refers to the fibrinolytic action of dextrose. We have not observed any marked solvent action of dextrose on fibrin, such as is found in Dakin's solution. It would be utterly illogical to attempt anything at all with hypertonic dextrose solution in the peritoneum, if it had such a fibrinolytic action because it would promptly convert a local into a spreading process.

#### CONCLUSIONS

1. Rapidity of absorption in the largest measure governs the prognosis of acute, diffuse peritonitis.
2. Fibrin is the most important factor in controlling the rate of absorption.
3. Fibrin is diminished or absent in the more virulent cases because of dilution of the exudate.

4. The streptococcus is most commonly identified with this abundant exudate and the accompanying virulent course of the disease.

5. The addition to such an inflammatory exudate of a transudate produced by the intraperitoneal injection of hypertonic dextrose solution produces a more rapid spread of the infection and insures the lethal outcome.

6. It seems probable that an abundance of thin exudate serves to prevent ileus by mechanical isolation of intestinal loops.

7. The results of this experimental study do not agree with the published reports of the similar treatment of peritonitis in man.

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## THE ABSORPTION OF GLUCOSE FROM THE COLON

A PRELIMINARY STUDY OF THE GLUCOSE ENEMA<sup>1</sup>

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THERE exist many missing links in our knowledge of the absorptive power of the large intestine. That certain substances enter the circulation of the human body when placed into the rectum is a commonly known fact. As Sollmann tells us ether is readily taken up by the lower bowel and complete general anesthesia is produced, this is a well known clinical phenomenon. Bromides are likewise absorbed when placed into the colon, and the bromide ion can be detected experimentally in the urine, the sweat, the tears, and other body secretions. It is less well known, however, how useful the sugar enema and other so called nutritive rectal administrations are. No modern text book of physiology, dietetics, or nutrition lacks a discussion on rectal feeding. Yet, a careful perusal of these writings will impress the reader with their delicious vagueness and will leave with him the suspicion that a great many statements are founded on insufficient evidence, not to say speculation.

The medical and biological journals of the last 15 years contain a voluminous mass of information on the therapeutic administration of glucose. However, when one sifts out those articles dealing with oral, subcutaneous and intravenous methods, there are left but scant experimental data on the colon as the portal of entrance of glucose into the body. Further more, it is still a matter of considerable controversy whether the rectum absorbs efficiently any nutritive substance.

## REVIEW OF THE LITERATURE

From Tallerman we learn that 180 cubic centimeters of a 33 per cent glucose solution injected slowly into the human rectum produce a slight and slow rise in the peripheral blood sugar level. Levi injected 500 cubic centimeters of glucose solution of strengths varying from 10 per cent to 20 per cent into the large bowel of normal fasting men, diabetic patients, and patients operated upon and

examined the peripheral blood for its sugar content. He concluded that the large bowel varied in different individuals as to its absorptive power, but that at best only small quantities of glucose were absorbed. Large amounts of 40 per cent glucose solution were introduced by Varela and Rubino into the rectal ampulla of patients and the peripheral blood and the urine tested for sugar. They claim that minute amounts are absorbed shortly following introduction, and that soon thereafter the colon becomes irritated and expels the enema. Franke and Wagner gave highly concentrated glucose enemas to dogs, and they state that they observed very little effect on the peripheral blood sugar level. Reach investigated the respiratory quotient after rectal injection of glucose and found that there was some absorption, slow and slight though it was. Han and Halasz, working on dogs, placed a ligature around the ileocecal valve and obtained a slight change in the respiratory quotient. Ornstein performed an experiment which is wide open to criticism. He introduced large quantities of sugar and starch mixed with proteins and fats into the rectum of dogs, and from analysis of the urine and washed out faces, 6 to 8 hours later, concluded that all the sugar and some of the starch were absorbed. McLester, Friedenwald and Ruraeh, and Hughson lead us to believe without experimental basis that glucose given by rectum is a valuable nutritive procedure. A different view is held by Nelson, who states that glucose placed into the large bowel is irritating and not often retained.

## COMMENT

The evidence gained from these various authors leaves us in a quandary as to the value of the glucose enema. Conflicting as these reports are, still certain facts emerge which are worthy of consideration.

First the solutions used by these workers are, without exception to a more or less

<sup>1</sup>This study was made in the Department of Physiology, Northwestern University Medical School, and we were greatly aided by valuable suggestion and friendly criticism from Dr. A. C. Ivy, head of that Department. Read before the Chicago Surgical Society, April 5, 1929.

degree hypertonic with the blood and tissue fluids. Theoretically, a 4.9 per cent glucose solution has the same osmotic tension as a 0.9 per cent sodium chloride solution. Kosaki found that a strength of 7 per cent was the most satisfactory, while strengths of 20 per cent and over caused destruction of the erythrocytes. Goldschmidt states that any solution of sufficient degree of hypertonicity will, when placed into the intestine, draw fluids into the gut. That this not only hinders absorption but may actually become a danger to life is brought out by Hausmann who introduced a 50 per cent solution of saccharose into the peritoneal cavity of rats, which promptly died from toxicity caused by the withdrawal of large quantities of fluids from the tissues into the peritoneal cavity. We believe, therefore, that a 4.5 or 5 per cent solution of glucose is the optimum strength for all therapeutic administration and that the high concentrations used by the various writers mentioned above are far too high to give conclusive results.

The second noteworthy fact in the experimental work cited above is that blood sugar estimations in all instances were made on the peripheral blood only. Starling tells us that the path of all absorption from the entire intestinal tract leads through the liver by way of the portal system. It is evident, therefore, that glucose absorbed from the intestine is submitted to the metabolic activity of the liver cells before it reaches the general circulation, and that a sugar determination made on the peripheral blood is not necessarily an index of the absorptive power of the intestine. In our work we have therefore made estimations on the portal blood, where rises in the blood sugar values represent actual absorption of the sugar solutions within the bowel unaffected by the activity of the liver.

The third outstanding fact is that no author to our knowledge has taken cognizance of the fermentative possibilities of the colon which is the normal reservoir for a huge number and variety of bacteria many of which have specific actions on specific sugars. This phase of the problem we have not yet taken up in our work, except that we have been careful to

forestall any appreciable decomposition of the sugar by bacteria by leaving the solutions in the bowel not longer than 1 hour and by titrating them immediately after removal.

#### EXPERIMENTAL WORK

In our experimental work we used a series of 15 dogs. These animals were picked at random, and they weighed from 20 to 35 pounds each. Food was withheld for about 16 to 18 hours. All the work was done under barbital hypnosis, 0.2 grams of sodium barbital per kilogram of body weight being given by stomach tube. One half hour later a small amount of ether was given to induce rapid anesthesia, after which the dog remained under light hypnosis throughout the experiment. The abdomen was opened and the entire colon isolated by ligatures around the ileocecal valve and the rectosigmoid junction. A loop of the distal ileum was likewise isolated by a ligature. An effort was made to have the loop of small bowel 50 per cent longer than that of the large bowel, which, roughly speaking, gives approximately equal absorbing surfaces in both. With all possible gentleness we then inserted glass cannulas into the four ends of the isolated loops and washed the contents out of the bowels in a proximo-distal direction with normal salt solution warmed to body temperature. After the solution returned perfectly clear and unhindered the bowel loops were completely emptied by tilting the table up into such a position that the exit cannulas were at the lowermost points of the loops and by gently blowing warm air through them. Then an accurately measured quantity of 5 per cent glucose solution at body temperature was placed into each loop and the cannulas closed. This amount we varied from 50 to 75 cubic centimeters according to the size of the dog, so that the bowels were in no instance over-distended by the contained solution. All protruding intestines were then replaced into the abdomen, the incised edges of the parietes were brought together and closed with a hemostat and covered with a warm towel. Exactly one half hour later the residual solutions were removed and the loops washed out with a definite quantity of warm saline solu-

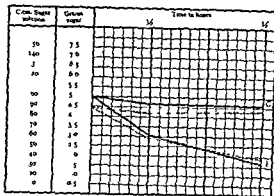


Chart 1. Dog F male 21 pounds. Glucose introduced into ileum 100 c cm. 4.42 gm. colon, 100 c cm., 4.42 gm. Glucose recovered from ileum 31 c cm. 1.32 gm. colon 92 c cm. 4.36 gm. Glucose lost from ileum 69 c cm. 2.61 gm. colon 8 c cm. 0.06 gm. Percentage recovered from ileum, 31 per cent c cm. 41 per cent gm. colon 92 per cent c cm. 98.7 per cent gm. Percentage lost from ileum 69 per cent c cm. 59 per cent gm. colon 8 per cent c cm. 1.3 per cent gm. Solid line indicates glucose solution broken line glucose C colon I ileum.

tion Next, the same volumes as before of 5 per cent glucose solution were again introduced into the bowel loops and allowed to remain 1 hour, after which the residues were recovered as before and the loops washed out to recover all glucose clinging to the mucosal folds or the walls of the funnel and cannulas. All the residual solutions recovered in this way were accurately measured to detect loss of water and were assayed by Benedict's quantitative method to determine loss of glucose. The saline washings were likewise measured and titrated in order to recover all possible glucose from the bowel loops. The total amount of solution introduced and recovered in cubic centimeters and the total quantity of glucose introduced and recovered in grams, were then calculated. In the process of each experiment the solutions were handled eight times and, consequently experimental errors in the form of loss of solution and of the contained sugar were unavoidable. After a considerable number of experiments we determined this error to be approximately from 1 to 2 cubic centimeters of solution and from 50 to 100 milligrams of sugar.

In all of these experiments we found a marked constancy in the action of the colon,

in contrast to a marked variation in the activity of the ileum. The amounts of sugar lost in the colon were so small as to be accountable for on the basis of experimental error, while from the ileum relatively large quantities were absorbed. In several dogs there was a slight absorption of fluid by the colon, thus leaving the remaining glucose solution slightly more concentrated than when introduced. From the ileum, in every instance, there was absorbed a considerable amount of glucose. Chart 1 illustrates graphically the results in a typical dog. The maximum amount of glucose solution which we were able to recover from the ileum in 1 1/2 hours was 82 per cent of the amount introduced, the minimum was 31 per cent. From the colon the corresponding figures are 96.6 per cent and 87 per cent, respectively. The maximum percentage of grams of glucose recovered from the ileum was 76.8 per cent, the minimum was 41 per cent. From the colon we recovered as little as 97.4 per cent and as much as 99.6 per cent of the original glucose introduced.

Summarizing these figures briefly in another way, we have a loss of glucose solution in the ileum varying from 18 per cent to 69 per cent, in the colon from 3.4 per cent to 13 per cent. Of the glucose introduced in terms of grams there was a loss in the ileum varying from 23.2 per cent to 59 per cent, in the colon from 0.4 per cent to 2.6 per cent.

Next we attacked the problem from the other side of the absorbing surface. In this group of experiments the dog was prepared in the same way, the abdomen opened, and the loops of ileum and colon isolated as before. Samples of blood were then taken from the large veins draining these loops. Then 5 per cent glucose solution was introduced as before. At intervals of 20 and 40 minutes blood samples were again withdrawn from the mesenteric veins of the isolated bowel loops. The sugar in the blood thus withdrawn was then determined by the colorimetric method of Folin and Wu.

The results were remarkably definite. In no case was there a rise in the blood sugar level of the blood from the colon loop and in all instances there appeared a marked rise in

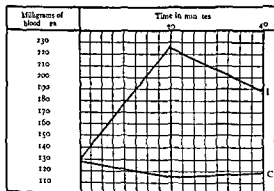


Chart 2 Dog N male 33 pounds Change in blood sugar level following glucose introduction I Ileal vein 130 mgm. 226 mgm, 186 mgm C Celiac vein 126 mgm 115 mgm 117 mgm

the blood from the loop of ileum Chart 2 is typical of this type of experiment It shows the blood sugar values immediately preceding and 20 and 40 minutes following the introduction of a 5 per cent glucose solution into the bowel loops

The third type of experiment concerns the absorption of tap water and of physiological salt solution from the same bowel loops used in the previous work The technique employed was exactly as before Of the tap water placed into the loops we recovered in one hour from the ileum 78.6 per cent, from the colon 57.3 per cent Of the physiological salt solution we recovered in one hour from the ileum 62.6 per cent, from the colon 52 per cent This shows definitely that the colon has the power to absorb these substances and does it better than the ileum (Chart 3)

#### SUMMARY

In summarizing our work briefly it is probably safe to say that there is no appreciable absorption of glucose in 5 per cent aqueous solution from the colon, while from the ileum considerable absorption takes place Tap water and normal salt solution are absorbed rapidly by both ileum and colon

#### DISCUSSION

In discussing our results in the light of the known physiological functions of the colon it becomes apparent that when a glucose solution is placed into the rectum one or more of the

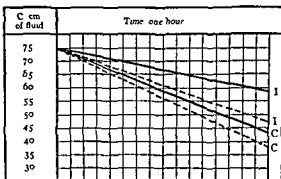


Chart 3 Dog O, female 34 pounds Fluids introduced into ileum 75 c cm colon 75 c cm Tap water recovered from ileum 59 c cm, 78.6 per cent colon 43 c cm, 57.3 per cent Tap water absorbed from ileum 16 c cm, 21.3 per cent colon 32 c cm, 42.6 per cent Normal salt solution recovered from ileum 47 c cm, 62.6 per cent colon 30 c cm, 52 per cent 0.9 per cent sodium chloride absorbed from ileum 28 c cm, 37.3 per cent, colon 36 c cm, 48 per cent Solid lines tap water broken lines saline C, colon I ileum

following things take place (1) it stays *in situ* unaltered, indefinitely, (2) it is expelled, (3) it changes in character by bacterial or other action, (4) it is absorbed, or (5) it passes into the small bowel

In the first three instances the rectal administration can probably be best described as useless if not indeed harmful In using high concentrations of glucose solutions Tallerman, Levi, Franke, et al, Ornstein, and Varela, et al probably introduced an irritant to the rectal mucous membrane, following which expulsion is the normal sequence This is the view held by Nelson It is also possible that, if not already irritating, a glucose solution can in a short time become so by the products of bacterial decomposition, chief among which are gas and lactic acid We believe that glucose is not appreciably absorbed from the colon, but that on rectal administration of any considerable quantity of solution the ileocecal valve becomes incompetent, and the glucose is regurgitated into the distal ileum, where absorption promptly takes place Such regurgitation is very probably not a normal procedure in the colon Cannon gave nutrient enemas to cats under the fluoroscope and found that a small enema will lie quietly in the descending colon,

but a larger one sets up antiperistaltic waves which force the fluid into the ileum. Gruetzner claims that substances which he introduced into the rectum were recovered in the stomach, being driven upward by antiperistalsis. Lurje made extensive studies on the actions of the colon and states that movements of tonic as well as antiperistaltic nature may occur in the proximal part of the colon. Case holds that the ileocecal valve becomes insufficient when there is obstruction or back pressure in the large bowel. Nagel also states that substances introduced rectally are not absorbed there but enter the distal ileum. Opposed to this view is Goldschmidt when he claims that absorption from the entire length of the intestinal tract involves a similar mechanism, and that differences of absorption at various points are quantitative differences rather than qualitative. He believes further that the presence of sodium chloride favors the absorption of glucose by acting as a chemical excitant. The study of the absorption of mixtures of sodium chloride and glucose solutions in various proportions is the next phase in our problem to be reported on.

We are aware of the differences existing between the large intestine of the dog and that of man. Such differences are primarily anatomical and are less important functionally and physiologically. Yet they must be kept in mind in the application of experimental results to clinical phenomena.

#### CONCLUSION

In view of all the evidence brought forward the uptake of rectally administered glucose probably depends on the passage of the enema into the ileum through an incompetent ileocecal valve. This very likely is the basis of success in the treatment of hyperemesis gravidarum by rectal glucose administration. The normally competent valve becomes insufficient on irritation or on sufficient pressure from below. Such a condition is not physiologically normal, and at best only small amounts of glucose can be forced into the blood stream in this way.

We conclude that a 5 per cent glucose enema is of little or no nutritional value.

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# SOME UTERINE ANOMALIES DUE TO VARIATIONS IN THE FUSION OF THE MUELLERIAN DUCTS

A PARTIAL REVIEW OF THE LITERATURE WITH A REPORT OF NINETEEN CASES SEEN AT THE BOSTON LYING-IN HOSPITAL AND THE FREE HOSPITAL FOR WOMEN, BROOKLINE, MASSACHUSETTS

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THE occurrence of double uterus is probably more frequent than is generally suspected. Since it is seldom recognized in general practice, its frequency, importance and interest are underestimated. Falls believes that 1 per cent of all uteri are bicornuate. Another writer estimates that 14 per cent of all uterine anomalies are of the bicornuate type. This figure is probably too conservative judging by the cases reported in the past 30 years. Disregarding figures however duplication of the uterus is one of the last thoughts to enter the mind of the obstetrician or gynecologist when parturition is unaccountably protracted or uterine dysfunction remains undiagnosed.

Authorities agree that the distal ends of the muellerian ducts, being in apposition in the genital cord and flanked by the mesonephric ducts which exert pressure in a medial direction, fuse at the 20 to 30 millimeter stage of the embryo and result in the unpaired anlage of the uterus and vagina. The remaining parts of the muellerian ducts lying cephalad to the genital core persist as pairs and become the uterine tubes. During the twelfth to the fourteenth week of embryonic life the formerly approximated medial walls disappear and fusion is completed. Canalization takes place from below upward thus forming the potential cavities of the vagina and uterus the process being completed between the twentieth and twenty fourth weeks. This substantiates the view of Burrage, who declares that the presence of two vaginal canals is a definite indication of a double uterus. Byford however, and several others hold that a septum may occur in a vagina or cervix only, the uterus being normally developed. Since cases with septate vagina and normal uterus are known to occur it is likely that canalization may begin in any portion of the genital core.

The following is Reed's table giving the nomenclature and explaining female genital anomalies as they occur in the stages of development.

## REED'S TABLE

### *Embryonic*

- 1 (a) Absence of tubes, uterus, and vagina. This is very rare. (b) One horned uterus with absence of the other horn (uterus unicornis sine ullo rudimento cornu alterius).
- 2 (a) Externally double uterus (uterus duplex sine didelphys, uterus bicornis). (b) Solid or partly excavated uterus (uterus solidus, uterus rudimentarius, uterus partim excavatus). (c) Combination of a and b (uterus duplex solidus, uterus bicornis rudimentarius). (d) One horned uterus with the other horn solid or partly excavated (uterus unicornis cum rudimento cornu alterius).
- 3 Uterus divided internally more or less completely with or without external signs or duplicity (uterus septus subseptus, uterus bicornis septus).

### *Fetal*

- 4 Uterus with flat fundus with or without complete or partial duplicity (uterus plani fundalis septus subseptus, simplex).
- 5 Uterus with fetal character (small body, large cervix).

### *Post natal*

- 6 Uterus with infantile character (uterus infantilis).

This table does not entirely cover uterine anomalies, as pointed out by Ballantyne who presented as an example the trifid uterus or uterus accessorius which is particularly difficult of embryonic explanation. Duplication of the muellerian duct on one side during the germinal period was given as a supposition.



Uterus didelphys, or completely double uterus internally and externally, is also missing in the above table

Theories as to the cause of uterine duplication are varied but the most acceptable is that described by Ancel and Villemin. Having found a case with a vesicorectal fold, they looked up 24 other cases with this fold and discovered that it occurred only in females and was accompanied in every instance by uterine duplication. They stated that the vesicorectal fold is vascular in origin, the segment from the upper rectum to the bladder being produced by a branch of the superior hæmorrhoidal artery and the remaining portion, which extends to the sigmoid, being formed by a collateral branch of that vessel.

Eden and Lockyer referred to the vesicorectal fold which they considered was either of allantoideal origin, being caused by fetal peritonitis or a relic of the terminal intestinal mesentery. Numerous other writers conceded that the vesicorectal fold was an etiological factor in uterine duplicity, but some, e.g., Nagel, deemed it the result.

Another theory is that the ducts of Mueller are held apart by abnormally short round ligaments. Piquand discussed the whole question of causation of length. Newton referred to Pick, who found tumors present in 30 cases of uterus duplex, and claimed that the presence of tumors had an etiological bearing. Felix and Rosenstein (31) stated that formative disturbances of the intestinal tract and developmental errors of the ventral abdominal wall were etiological factors. Von Franque substantiates this view with a report of four cases. Jacobs reported a case of bicornuate uterus in which there was a congenital absence of the appendix (agenesis). Like many other pathological conditions uterine anomalies are probably due to a combination of causes. Moench very well said that phylogenetic youth and intricacy of structure inherently cause vulnerability.

The literature deals for the most part with obstetrical difficulties in the various forms of uterine duplication. Very little has been reported on the gynecological conditions arising therefrom. At the clinic of the Free Hospital for Women, Brookline, Massachusetts, 11

cases of bicornuate uterus have been encountered. Five of the 11 patients were single and nulliparous, 3 were married and nulliparous, 3 were married and had 4, 3, and 2 children respectively, each having had in addition two miscarriages. Seven of the series complained of dysmenorrhœa in none of whom was hæmatocolpos or hæmatometra found. Five of the whole group complained of menorrhagia and one of metrorrhagia. One patient menstruated regularly every 3 weeks and one every 2 weeks. Whether or not menstruation occurred alternately from either side of the double uterus is unknown.

At operation pelvic inflammation was found in 5 cases. The presence of a vesicorectal fold was recorded in only two. In 3 cases the pre-operative diagnosis had been of fibroid tumor. At operation a small fibroid only was found in one of these. Undiagnosed fibroids were found in 3 other cases. The ovaries were undescended in 2 patients. One patient with hæmatocolpos and hæmatometra had not complained of dysmenorrhœa. Three unilateral and three bilateral supravaginal hysterectomies were performed. One of the patients who had had a unilateral hysterectomy had a normal labor at a later date. Two patients had no abdominal operation, one was explored and two had uterine suspensions.

Seven cases were classed under 2a in Reed's table (uterus duplex sine didelphys uterus bicornis), 2 were classed under 4 in the table, and 2 were didelphys uteri since there was complete duplication of body, cervix, and vagina.

Menstruation in a bicornuate uterus is as complete as in a single uterus, but it is heir to more pathological possibilities. All writers agree that dysmenorrhœa may be caused by retention in a rudimentary horn. In this series however no dysmenorrhœa could be attributed to retention. The diagnosis is based on the finding of an associated periodic swelling due to retention in the rudimentary horn when the menstrual flow is apparently normal in amount (unilateral hæmatocolpos due to atresia vaginalis lateralis). Dudley reported a case of intractable dysmenorrhœa with failing health in which he found a bicornuate uterus. Removal of both horns resulted

in a cure McArthur described an operation for bicornuate uterus performed on a patient suffering from severe dysmenorrhœa. He cut the vaginal septum from below and then removed the remainder of the septum by the abdominal route joining the cut edges of the uterus as one would a rupture. There was complete recovery. In neither of these cases was hæmatocolpos or hæmatometra present.

Bainbridge stated that menstruation may take place every 2 weeks, first from one side, then from the other, the patient losing in all about as much blood as during a normal period. He stated also that one horn may menstruate while a pregnancy exists in the other. Among the 8 cases of uterus duplex reported in the records of the Boston Lying in Hospital no bleeding occurred during pregnancy. Moench said that while pregnancy exists in one horn, the other ceases to menstruate. Cleveland described the discharge of an anomalous decidua during pregnancy in a case of bicornuate uterus. The membrane probably came from the unimpregnated horn.

Pregnancy in uterus duplex has been widely discussed. There was no indication that sterility occurred more often than it does in single uteri. A small majority in the literature and 6 of the 8 cases in the records of the Boston Lying in Hospital were primiparæ. Numerous repeated pregnancies, even after unilateral hysterectomy, have been reported.

In cases of uterus duplex, abortions are common, the number depending probably on the frequency with which implantation takes place in the rudimentary horn. This is essentially an extra uterine pregnancy. The ill-developed horn cannot accommodate its rapidly growing physiological tumor, and abortion results. Rupture of one horn in the early months of pregnancy occasionally occurs, but abortion with expulsion of the products by the natural route is usual. Picot (2) reported a case in which there were 14 abortions, and Gautermann (2) cited a case in which three children were born from the right horn and nine abortions occurred from the left.

Hirst and Herman stated that it is impossible to make a diagnosis between tubal pregnancy and pregnancy in a rudimentary horn.

Kelly and Noble, however, stated that the diagnosis may be made by the position of the round ligament, which in the latter is connected with the distal side of the tumor instead of with the proximal portion as in the former.

Pregnancy in bicornuate uterus is rarely interrupted between the third and the eighth month, frequently it goes on beyond term. If rupture occurs it is during the last month or at labor. Uneven distribution of uterine muscle and misdirected forces serve to protract labor and weaken the uterine wall, increasing the danger of rupture. In one of the Boston Lying in Hospital cases, the head of the child protruded through a ruptured fundus.

There seems to be some difference of opinion among obstetricians regarding the extent to which a double uterus may complicate labor. Transverse positions are common and in primiparæ should lead one to think of this anomaly. Labor is long, pains are weak, intra uterine death is frequent. Irregularity of the fetal heart is common, not only during labor but in the later months of pregnancy. Deformities of the fetus, such as scoliosis, talipes equinus and, oddly enough, polydactylism, are not infrequent. DeLee reported a difficult delivery in which the child straddled the septum of a partially septate uterus. Placentas are more frequently adherent and are often bipartite. A succenturiate lobe may be present. Findlay said that placental tissue is likely to be retained in the uterus and lead to infection and hæmorrhage.

In Falls' series of 15 cases 6 primiparæ were in labor over 17½ hours. Cæsarean section was performed on one of these after 41 hours of labor. Of the 8 Boston Lying in Hospital cases, one was in labor slightly over 17 hours and was delivered by low forceps, one had a 10 hour labor and was delivered by mid forceps, one went 48 hours and was then delivered by cæsarean section. In this case the uterus had just begun to split. Four of the remaining cases had cæsarean section. One of these had a ruptured uterus at 5½ months, having previously had four normal deliveries. The eighth case had a premature separation of the placenta and delivered herself of a 7 months macerated fetus.

Falls estimated that the average blood loss is 500 cubic centimeters which is twice the normal average. Involution is usually delayed.

Operative measures are recommended by Rockey, McArthur, Strassmann, and Dannreuther, if the condition is diagnosed in non-pregnant women. Rockey clamps the upper and lower borders of the vaginal and uterine septum and leaves the clamps in place for 36 hours. He advocates the same procedure for bicornuate uteri, but he puts the patient in the Trendelenburg position and closes the clamp slowly to obviate the possibility of catching gut between the two horns. His patient has since had two normal pregnancies.

McArthur's operation is described above. Strassmann (15) in discussing Falls' paper proposed an operation for uniting the two horns, i.e., to incise the fundus from one to the other and then to join the two halves.

Dannreuther (15) in discussing the same paper stated that the bladder is frequently displaced upward because of its attachment to the rectovesical fold. He advised separating the fold well back in the sulcus, because if the patient ever comes to hysterectomy the transverse incision across the uterovesical peritoneal fold customary in hysterectomy would jeopardize the bladder wall.

Numerous odd cases are reported in the literature. In 1896 Cullen and Wilkins (25) reported a case of pregnancy in the rudimentary horn and collected 39 other cases. In 1900, Kehrer collected 84 cases. In 78 of these the proximal end of the rudimentary horn did not communicate with the uterine cavity, and pregnancy must have followed external migration of the *spermatozoon* or *ovum*. Caswell and Horn both reported cases of torsion of the pregnant half of a uterus didelphys. Caswell's case went through a normal pregnancy after partial hysterectomy.

Falk artificially aborted a woman with grave heart disease who was 2 months pregnant. She returned 3 months later with her uterus corresponding to a 5 months pregnancy. This was due to another *ovum* situated in the other half of a bicornuate uterus.

Monat reported a case of a rudimentary horn in an inguinal hernia. He stated that

there were only 37 on record and that a great majority occurred on the left side. He advised operating only to reduce the hernia.

A bicornuate uterus or uterus didelphys is the popular explanation for superfetation and superfecundation. Twin pregnancies are frequently reported in double uteri, and Ross reported a triple pregnancy. According to Bainbridge Dibierry quoted an instance of a woman who bore one child on July 16, 1870, and another on October 31, of the same year both full term. She had had three menstrual periods between the confinements. Jellinghaus reported one case of a full term child in one horn and a 4 months' fresh fetus in the other, and another in which the patient was delivered of a full term white child from the left horn and 2 months later of a full term black infant from the right horn. The father's race and ancestry were not included in the report.

#### SUMMARY AND CONCLUSIONS

1 The etiology of bicornuate uterus probably lies in some mechanical obstruction preventing complete union of the paired ducts of Mueller.

2 A bicornuate uterus is heir to the same gynecological conditions as a single uterus more frequently than to its unique tendency to dysfunction.

3 The obstetrician must be awake to the possibility of a dual organ and its potential catastrophes if labor is uncommonly slow, if the fetal heart is irregular and rapid before labor begins, in all malpositions, particularly in primiparae and when there is a history of repeated abortions before the fourth month.

4 Operative procedures are advisable in view of possible future pregnancies.

5 Superfetation may attribute its success to bicornuate, septate, or didelphys uterus.

For permission to report the Free Hospital cases and for assistance the author wishes to express his thanks to Dr. William P. Graves at whose invitation this study was undertaken. He is grateful to the staff of the Boston Lying-in Hospital for permission to report their cases.

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## THE RELATION OF MATERNAL PELVIC DISEASE TO DEFORMITIES IN THE NEWBORN

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ONE of the theories regarding the causation of monstrosities and other gross morphologic defects attributes them to disease of the generative organs. Many believed that environmental conditions, interfering with the proper implantation of the ovum, were the chief contributing influences, and that endometrial disease was among the most important of these. Our intention is not to discuss here the relative validity of the different theories, but merely to present some recently collected observations on the relationship between pelvic disease and the formation of severe anatomical defects in the newborn child.

Pelvic disease with uterine hemorrhage frequently renders a patient incapable of bearing children. It is, for this reason, difficult to secure records of any larger number of pregnancies in women with pelvic disease.

In a recent investigation (6, 7, 8) of the effect of pelvic radiotherapy on the health of subsequent children, we studied the records of a great many women who received roentgen or radium treatments for pelvic disease while non-pregnant, and who at a later date bore children. Most of these children were healthy while a small number were unhealthy or otherwise defective. The factors responsible for the ill health were readily determined in many cases. Irradiation was not believed to be the cause of the ill health or deformities in any of them. The question which now had to be considered was: Could the ovarian or uterine disease have caused the anatomical defects of obscure origin, exhibited by several of the children?

The large number of births, in women who had received therapeutic irradiation for pelvic disease, offered an excellent opportunity to study the relationship between such disease in the mother and malformations in the children.

A review has been made of the health reports of 310 children born of women suffering

from pelvic disease. Approximately one third of the mothers of these children suffered from idiopathic uterine hemorrhage, and one third had myomata. The remainder were treated for various other gynecologic conditions, such as adnexitis, amenorrhoea, and carcinoma of the cervix or vulva.

Among the 310 children mentioned above, 3 (1 in 103) were grossly deformed (Table I). Most of the remaining 307 were healthy, although several were unhealthy. The incidence of ill health was not believed to be greater than the usual incidence. The pelvic disturbances manifested by the mothers of the 3 malformed children are described in Table II.

In order to determine how the ratio of 1:103 compared with the birth rate of monsters in the general population, the statistics in Table III were assembled. Of the 95,366 children 419 (0.4 per cent) were grossly deformed. The ratios for the various groups forming this total ranged from 1:111 to 1:456. A comparison indicates that pelvic irradiation has relatively slight influence upon the birth rate of monsters. If the diseases associated with uterine hemorrhage had played an important rôle in the production of deformities it is believed that the percentage of malformed children (0.97 per cent) born of the women with pelvic disease would have been considerably greater than that (0.4 per cent) in the general population.

In considering the relationship between pelvic disease and the birth of monsters, it must be borne in mind that many women with disease of the pelvic organs undoubtedly improve under irradiation treatment. The influence of such treatment upon the incidence of defective production, however, cannot be stated. Disregarding this complicating factor, it is believed that uterine disease is negligible as a factor in producing deformities in the offspring. The observations recorded here, although representing only a small group of individuals, strongly suggest that uterine

TABLE I—INCIDENCE OF GROSS DEFORMITIES AMONG CHILDREN BORN OF WOMEN SUFFERING FROM PELVIC DISEASE AND TREATED BY IRRADIATION

Births	310
Malformed children (0.97 per cent)	3
Ratio	1:103

TABLE II—TYPE OF PELVIC DISTURBANCE SUFFERED BY THE MOTHERS OF THREE DEFORMED CHILDREN

Author	Pelvic condition	Malformation
1 Coffey	Metrorrhagia	Anencephaly
2 Gummert	Myoma uteri	Microcephaly
3 Moeller	Menorrhagia	Hydrocephaly

TABLE III—BIRTH RATE OF MALFORMED CHILDREN IN THE GENERAL POPULATION

Source of data	Births	Malformations	Ratio
Chausser*	22,203	132	1:169
Puech*	778	7	1:111
Schworer*	39,917	88	1:456
Winckel	12,375	87	1:142
Winckel	20,000	105	1:190
Total	95,166	410	

Quoted from Marchand  
to 4 per cent

disease characterized by hemorrhage does not increase the tendency to the production of malformations in the subsequent children

However, it is realized that endometrial disease may be an important factor in the production of abortion

# CONCLUSION

It is concluded from this study that uterine or ovarian disease apparently has no relation to the production of deformities in the newborn child

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# CLINICAL SURGERY

FROM THE MAYO CLINIC

## THE MANAGEMENT OF LESIONS OF THE POSTERIOR WALL OF THE DUODENUM<sup>1</sup>

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ULCERS of the posterior wall of the duodenum present a difficult surgical problem. Such ulcers are much more common than is generally recognized. The majority of lesions which are found in the duodenum at necropsy are on the posterior wall and it is a common experience, in those operations which permit satisfactory exposure to encounter one or more ulcers in various stages of development on the posterior aspect of the duodenum. The significance of such lesions, I believe, has not been sufficiently appreciated.

It is not an infrequent experience, in operating on a patient who has given a typical history of duodenal ulcer, to find that the anterior wall presents little evidence of an ulcer, and that on palpation, there appears to be no lesion posteriorly. However in many such cases if the duodenum is opened, and the posterior wall carefully examined under direct vision, a perforating ulcer is found on the posterior wall. The lesion may not have given signs of its presence to the roentgenologist and the diagnosis of peptic ulcer may have been made on symptoms alone. I have met with a number of instances in which there has not been any appreciable evidence of inflammatory reaction in the anterior wall and in which there has been a crater in the posterior wall which could not be identified in any other way than by visualization. In some of these, hemorrhage had been the predominant symptom. Under such circumstances, the importance of visualizing the lesion cannot be overestimated inasmuch as the prospects of immediate relief and protection against subsequent hemorrhage depend, to a considerable extent on the eradication of the lesion. Nevertheless when a local procedure does not seem advisable because of technical difficulties, the curative value of gastroenterostomy for hemorrhagic duodenal ulcer wherever it may be situated, should not be overlooked.

In other cases, the presence of an ulcer situated posteriorly is suggested by an obvious inflammatory process of the anterior wall which is characterized by stippling on palpation, and thickening of the duodenal wall, without any characteristic scarring. In many cases excision of the anterior inflammatory area will disclose a well defined crater on the posterior wall. Removal of an anterior ulcer without visualization of the posterior wall, leads to error. In other types of cases, a well defined ulcer of the anterior wall with a distinct crater of considerable size may be associated with one or more other lesions on the posterior wall. It is hardly necessary to point out the importance of knowing whether or not a lesion exists in the posterior wall since failure to identify such a lesion may easily explain some of the disappointing results which follow operations particularly when the patient's history has been characterized by repeated hemorrhage. A safe rule to follow, therefore is that a lesion in the posterior wall should always be suspected when there is a history of bleeding.

When lesions are encountered in the posterior wall the surgical management will vary considerably. It has been my practice when it seems desirable or feasible to carry out excision of a lesion in the anterior wall first to open the stomach about 2 or 3 centimeters proximal to the pylorus midway between the greater and lesser curvatures. The opening should be large enough to admit the finger and to permit careful exploration of the posterior wall of the duodenum. If a crater is found posteriorly and if from its size and distance from the pylorus it seems unwise to attempt its removal the opening made for the exploration is closed and the management of the lesion carried out by performing either posterior or anterior gastro-enterostomy. If the posterior crater appears to be excisable, the exploratory incision may be extended around the anterior lesion with removal of sufficient tissue

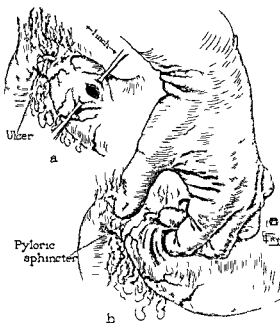


Fig 1 Exploration of duodenum

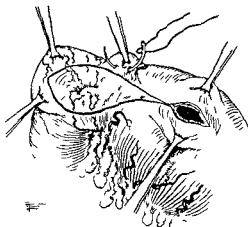


Fig 2 Excision of ulcer on anterior wall of duodenum

from the anterior aspect of the antrum pylorus and duodenum (the importance of which has been emphasized by Judd) so that in the subsequent reconstruction of the pyloric outlet a satisfactory lumen can be made.

The methods by which ulcer of the posterior wall of the duodenum may be dealt with are numerous. They are (1) excision by cautery combined with pyloroplasty or gastroenterostomy, (2) excision by knife with reconstruction of the pylorus by the method of Heineke Mikulicz, Finney, C. H. Mayo, Judd or Horsley, (3) partial duodenectomy by the Billroth I method or one of its modifications, and (4) partial duodenectomy and partial gastrectomy by the Billroth II method, the Polya method and so forth.

I wish particularly to draw attention again to a method of excision by cautery of lesions of the posterior wall of the duodenum. It is reasonable to assume that when a bleeding type of ulcer is present it is desirable that it be removed. Unfortunately the ulcer may be so situated the duodenum may be so deeply placed or a periduodenal inflammatory process may be so extensive that excision is prohibited because of the risk entailed. In the majority of cases, however, satisfactory removal may be effected when the anterior aspect of the pyloric end of the stomach, the pylorus and the duodenum have been widely opened and the posterior wall clearly exposed.

Then the ulcer can be dealt with according to its situation. If the posterior lesion is near the inferior or superior border of the duodenum, the incision can be continued around the lumen to include the ulcer and the resulting defect closed. This procedure is followed by reconstruction of the anterior defect. If however, the ulcer is centrally situated and is distant from the pylorus the cautery offers a safe and direct method of excision. If the full effect of the cautery is employed the posterior lesion can be excised completely and the resulting defect can be repaired by sutures introduced from the mucosal side. In the majority of cases following this procedure the anterior defect can be reconstructed so that a satisfactory outlet of the stomach is obtained.

When the nature of an anterior lesion indicates the advisability of excision of a portion of the anterior wall, or when it is necessary to visualize the posterior wall because of the absence of any clear evidence of a lesion anteriorly, and when

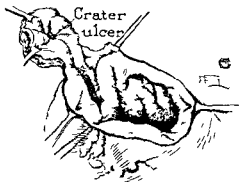


Fig 3 Excision of ulcer on anterior wall of duodenum



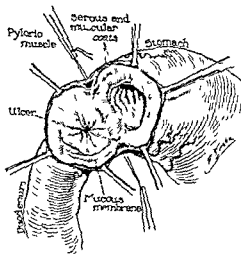


Fig. 4 Typical ulcer of the posterior wall of duodenum

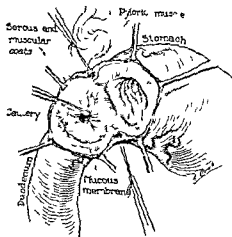


Fig. 5 Cautery excision of ulcer

the history and roentgenographic evidence is positive for ulcer, the duodenum and pylorus are first mobilized to a reasonable extent packs are carefully placed around the duodenum, and the liver is retracted so that adequate exposure of the entire first part of the duodenum is possible. The site of any inflammatory process in the anterior wall of the duodenum is marked off by Allis forceps, placed on the inferior and superior borders of the duodenum, slightly below the level of the inflammatory area. Similar forceps are placed on the greater and lesser curvatures of the stomach, about 3 or 4 centimeters proximal to the

pylorus. The pyloric muscle is then deeply transfixed by two sutures, one near the greater curvature and one near the lesser curvature. The stomach is opened about 2 or 3 centimeters above the pylorus and any gastric content is aspirated by the suction pump. The finger is introduced through this opening and through the pylorus and careful exploration is made of the interior of the duodenum (Fig. 1). If it seems advisable to continue with the excision the incision is carried down through the pyloric muscle to the inner side of the sutures already placed the pyloric flap thus made is reflected the mucosa of the anterior wall of the duodenum is inspected and whatever lesion is present is excised by continuing the dissection in the uninvolved portion of the duodenal wall (Figs. 2 and 3). The two sutures of catgut which have been placed in the pyloric muscle can be used as tractors and the posterior wall can be satisfactorily exposed. It is most important to avoid any rough manipulation of the mucosa of the posterior wall, since it can easily be traumatized by the forceps or even by a sponge and the field obscured.

It is in awkwardly situated posterior lesions that the particular value of the cautery is found (Fig. 4). When the base of the lesion has been cleansed by careful sponging the point of the cautery is carried around the circumference of the lesion until the mucosa is loosened and the cauterization of the base is continued until the ulcer is, to all intents and purposes, excised (Fig. 5). It is of considerable importance that such cauterization be done slowly, inasmuch as a low degree of heat is most effective. Such excision

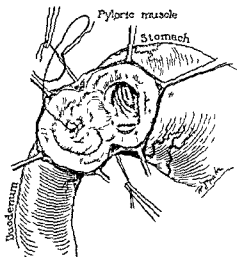


Fig. 6 Closure with chromic catgut of defect following cautery excision of ulcer

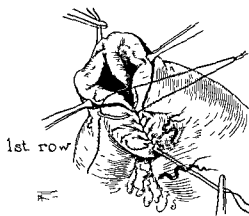


Fig 7 Reconstruction after excision of ulcer of the duodenum

is not associated with bleeding and the mucosal edges of the lesion are sufficiently excised by the cautery so that deep sutures of catgut can be used to obliterate the defect which has been made by the cautery (Fig 6). Chromic catgut is the most desirable suture material to use, and the continuous figure of eight stitch is the most satisfactory method of closing the defect. When the lesion has been so dealt with the opening in the anterior wall of the duodenum, pylorus and pyloric end of the stomach is closed in a transverse direction, the closure is made by continuous and interrupted sutures of catgut and the upper and lower angles of the incision are reinforced by omental flaps (Fig 7). The pyloric end of the stomach is sutured to the round ligament of the liver by sutures of catgut, as originally suggested by W J Mayo (Fig 8). This procedure of dealing with an ulcer of the posterior wall has the

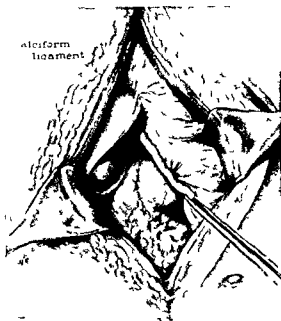


Fig 8 Fixation of pyloric end of the stomach to the round ligament of the liver

advantage of simplicity and efficiency, and in many cases seems the only reasonable direct procedure which can be used. In other words, it is often a question of either excision by cautery, or nothing. The results of operation have been very satisfactory for posteriorly situated ulcers associated with severe bleeding and the mortality rate has been low. During the last 3 years in the clinic 52 lesions of the posterior wall have been dealt with in this manner, with one death.

## FROM THE DEPARTMENT OF ORTHOPEDICS, NEW YORK POST-GRADUATE MEDICAL SCHOOL

TREATMENT OF UNUNITED FRACTURE OF THE NECK OF THE FEMUR<sup>1</sup>

FRED H. ALBEE, M.D. SC.D. F.A.C.S. NEW YORK

IN 1927, in order to compare the results achieved by the two operations which I have been employing for many years in the treatment of ununited fracture of the neck of the femur, I assembled a consecutive series of cases in which one or the other operation had been performed. Sufficient data were collected to enable me to report the results in 36 cases of the bone graft peg operation and 44 cases of my partial arthroplastic or reconstruction operation (1).

From this experience I learned again the value of reviewing one's results and correcting impressions by cold statistics. I learned a still more valuable lesson—that progression sometimes entails the necessity of changing one's mind. Previously I had favored the reconstruction operation and had committed myself to the statement that it was indicated in about 90 per cent of the cases seen late (2). I duly confessed my error and recanted. My subsequent experience, as I shall report it today, has only strengthened my determination to employ the autogenous bone peg operation in a larger percentage of cases.

## THE BONE GRAFT PEG OPERATION

I first described this operation in 1913 in *Murphy's Clinics*. The joint is exposed by an anterior incision straight downward from the anterior superior spine; a second is made over the great trochanter for the purpose of inserting the bone graft peg. The neck of the femur is inspected through the anterior incision. Eversion of the foot and limb causes the femoral fragments to separate anteriorly and the ends of both are then thoroughly freshened with osteotome and mallet. The foot is then restored to the anteroposterior axis and sufficient abduction (about 30 degrees) and traction applied by means of the table, to bring the freshened fragment ends into close apposition.

Attention is next turned to the short incision over the trochanter which has been carried down to the fascia covering the vastus externus. These structures are now both split longitudinally so as to expose the lateral surface of the great trochanter. The point of application of the drill lies  $\frac{1}{2}$  inch below the bony ridge to which the

fascia overlying the vastus externus is attached. Since the direction of the drill must follow the central line of the neck, due consideration must be given to the angulation of the neck to both the axis of the femur and the vertical intertrochanteric plane. In the average adult, the neck makes an angle of 130 degrees with the femur, and 12 degrees with the vertical intertrochanteric plane, when the foot is in the anteroposterior plane.

With the motor drill held in the direction thus indicated a hole  $\frac{1}{2}$  inch in diameter is drilled through from the lateral aspect of the great trochanter to the broken end of the distal fragment. This point is determined by instrumental palpation of the head of the drill between the apposed fragments. The reading on the drill indicates the length of penetration through the distal fragment. With the drill held against the freshened end of the capital fragment it is now carried into this fragment until the reading shows sufficient penetration. The degree of penetration is usually 7 or 8 centimeters ( $2\frac{1}{2}$  inches) and is determined by a study of the roentgenogram. The drill is left *in situ* while a graft is taken from the crest of the tibia of the same side.

The tibia is exposed by a generous incision over its lower third. This lower portion is preferred on account of the greater thickness and strength of the cortex. A portion is chosen where the crest is straight and regular and the muscle and soft tissues dissected away. With my motor saw a longitudinal cut is made on each side of the crest at a suitable angle with each other and an interval sufficient to provide a peg  $\frac{1}{2}$  inch in diameter after shaping (Fig. 3). Two transverse saw cuts are now made at an interval equal to the reading on the drill and the segment loosened by means of an osteotome and gentle blows of a mallet. The selected end of this segment is seized by two Ochsner clamps. The other end is inserted in the pencil sharpener cutter attached to the dowel shaper, by means of which the end is shaped to a blunt conical point favorable not only for subsequent engagement in the dowel tool, but for reception in the drill hole already prepared in the femoral fragments. The pencil sharpener attachment is now replaced by the dowel tool and the

<sup>1</sup>Read before Pac. Pacific Surgical Congress, Honolulu, August 21, 1929.

peg run through it. During both these shaping processes, a drip of normal saline is arranged to fall constantly on the tool not only to hasten its cutting but to relieve any possibility of undue heat. The saline solution also prevents dehydration of the graft by exposure to the air. Moreover, in the industries either oil or saline solutions are used in the cutting of hard substances for the purpose of clearing debris from the path of the cutting instrument as well as for increasing the speed of cutting and for diminishing friction. The peg is now inserted into the drill hole in the trochanter (after removal of the drill) and driven home with the bone drift and mallet. With the end of the handle of a wooden mallet against the great trochanter, close to the peg graft and by means of blows of the palm of the hand or a sand bag against the head of the mallet I attempt to secure close approximation of the fragments. The deep fascia is closed by interrupted sutures of No. 1 chromic catgut and the skin with a continuous suture of No. 6 plain catgut. The limb is put up in a posture of slight abduction in a double plaster-of-Paris spica extending to the base of the toes on the affected side and to the knee on the sound side.

Let us examine in detail some of the points in this description of the operation. I have mentioned the necessity for consideration of the relation of the neck of the femur to the planes of the body. It was stated at a recent meeting of some of the world's most eminent orthopedic surgeons that the operation was "too difficult for any but the special few." I would be in agreement with that statement if it were impossible for all but the few to visualize the course of the femoral neck and to direct their operative procedure in accordance with the clear anatomical demands. The results which one eminent surgeon showed in roentgenograms of bone pegs that missed the capital fragment entirely or went clear through into the pelvis, would make one tremble for the future of surgery if it were to forsake so completely its foundation on the precision of anatomy.

Success in surgery depends more on anticipation of difficulties than on skill in overcoming the unexpected. By means of the graduated drill and palpation between the fragments one can determine the point to which the drill hole ought to be carried. No phenomenal skill is required all that is demanded is preparation, prevision, and precision.

Such unfavorable experiences have no particular point against the bone graft peg, they are equally applicable to pegs made of dead bone and to nails which I never advise, however.



Fig. 1. Unsuccessful use of nail in fracture of the neck of the femur. The destruction of bone has been so great that the nail has changed its course 40 degrees. Extensive cavitation of both fragments found at operation.

This surgeon's criticism of the bone graft peg, on the ground that it degenerated at the point of junction and finally disappeared, would have been disconcerting if I had not known his predilection for manual methods and if he had not made the casual admission that his opinion was based on experience with one solitary case.

It is my conviction, after mature study of both fresh and ununited fracture of the neck of the femur that from the standpoint of mechanical immobilization the Whitman abduction method offers everything that can be desired. If it is properly applied it brings about ideal approximation of the fractured surfaces and provides ideal conditions for immobilization. If, after skillful and correct application of this method in fresh fractures, the fragments do not unite, the problem goes beyond mere mechanics and becomes a biological as well as a physiological one: the principal requirement being to bring blood supply to the point of non union as well as a flow from one fragment to the other, or in other words a collateral circulation. Neither in fresh fractures nor in non union is the use of nails justifiable. There is nothing they can accomplish in fresh fracture that the Whitman method will not. Since nailing is, at the best, scarcely more effective in immobilizing than Whitman's method, the latter, being non operative, should have the choice. Even the method advocated by Smith-Petersen of using a nail with flanges cannot hope to supplant the Whitman method. In my opinion,

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<sup>1</sup>Read before Pan Pacific Surgical Congress Honolulu August 23 1929

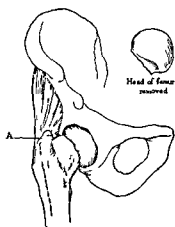


Fig 4

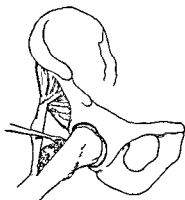


Fig 5

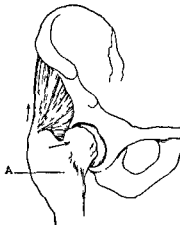


Fig 6

Fig 4 Schematic drawing of author's reconstruction operation with removal of femoral head. dotted line indicates bone section of upper end of femur by broad osteotome

Fig 5 Displacement of upper end of bone muscle lever outward by abduction of hip which automatically thrusts the new femoral head into the acetabulum at the same time

holding the bone muscle lever in oblique relation to the shaft. The angle is then filled with cancellous bone material from greater trochanter as indicated.

Fig 6 Drawing from X-ray showing consolidation of union of bone muscle lever with main portion of femur angle being filled in.

3 By all means the most important is the faulty blood supply. The neck and head have a meager blood supply on account of the absence of soft parts, through the attachments of which, in other areas than joints, circulation is supplied to the periosteum and bone. Even the fractured surfaces secure all their blood supply by way of minute blood vessels traversing the bone itself, there being no auxiliary supply from the surface.

It was shown by the extensive experimental work of Johnson that the rate of osteogenesis is in direct relation to the flow of blood to the zone of fracture. My clinical experience substantiates his conclusions.

If the fracture occurs in the central portion, the sole supply of the capital fragment is through the ligamentum teres. Even if the vessels in this structure are not damaged, the blood thus supplied is not adequate for even the normal vitality of the head, much less for osteogenesis and union.

The meagerness of the blood supply to the head of the femur was impressed on me by the study of the large number of capital fragments removed during the reconstruction operation. Phemister's experience has been similar. We have both observed much degeneration except in the zone immediately contiguous to the ligamentum teres and its vessels (Fig 2).

Sir Arthur Keith, whose profound studies of bone growth are known to all, recently showed me some specimens at the museum of the Royal

College of Surgeons to substantiate his belief in the early and remarkable vascularization of bone grafts. After the insertion of a bone graft peg through the fragments, the haversian canals are enlarged and canalized by new vessels. The cancellous bone at the endosteal angle of the tibial peg, though small in amount, also acts as a conducting scaffold for blood vessels which penetrate it from the vascular tissues overlying the trochanter and the vascular cancellous bone of the trochanter where the peg traverses it, and conducts them through the point of non union and into the anæmic capital fragment (Fig 2).

Campbell states that non union increases rapidly with old age. This is dependent, I believe not so much on general failure of recuperative power or diminution of osteogenetic power as on senile restriction of circulation.

#### AUTHOR'S RECONSTRUCTION OPERATION

For the reconstruction operation the approach is that devised by Smith Petersen and is very similar to the Sprengel approach. The skin incision consists of two parts: (1) from the anterior superior spine directly downward, and (2) from this point over the anterior superior spine directly backward along the crest of the ilium for a distance of 3 or 4 inches. With a scalpel the fascia lata is severed parallel with the crest of the ilium and sufficiently below it to leave a fascial flap to receive sutures in the approximation of

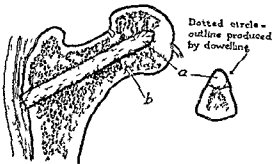


Fig 2 Schematic sagittal section of bone graft peg in place in ununited fracture of the hip. Different shading of cancellous bone of head near ligamentum teres indicates bone of different texture because of preservation of vitality by blood supply through ligamentum tissue. The rest of the cancellous bone of the capital fragment shows evidence of ischemia which the bone graft peg when properly inserted overcomes by acting as a vascular conducting scaffold from the vascular cancellous bone of the distal fragment and the muscles overlying the distal end of the peg. *a* Indicates haversian canals which are being canalized from these sources. *b* indicates the callus which is built up between the femoral fragments and around the peg.

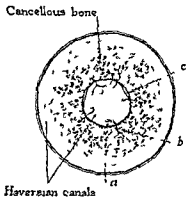


Fig 3 Schematic cross section of bone graft peg in place in neck of femur. Shows same canalization (*b*) and consequent vascularization of the capital fragment and same blood supply to callus as is represented in sagittal section in Figure 2. *a* Represents the cancellous bone at the endosteal angle of the crest of the tibia. *c* represents osteogenic portion of periosteum.

our waning faith in nails is not going to be restored by changes in the shape of the nail. The fault lies with the foreign body itself as those of us who have been removing nails for years and observing their destructive effect on bone can emphatically attest.

The same argument holds in regard to ununited fracture. If Whitman's method carefully and accurately followed, has failed it is not sound surgery to expect some other, hardly more efficient form of immobilization to be effective (Fig 1). The history of the case demonstrates that something more than immobilization is necessary. Stimulation of osteogenesis is required, but still more vital is the nutrition and blood supply to the point of union and the anemic capital fragment. This can be ensured only by the autogenous bone graft peg inserted by a most accurate fit. This can be accomplished only by the use of electrically driven automatic machinery which brings about a fit commensurate with that of a glass stopper in a bottle. The insertion of graft should not produce compression by too tight or inaccurate a fit nor should there be a dead space filled with air, blood clot or tissue debris, between the surface of the graft and the host bone tissues. In other words there should be the closest coaptation of the haversian canals of the host and graft tissues so that early and complete canalization of the graft will take place.

A graft of irregular shaped cross section will not do. At the corners of the graft there will be compression resulting in both occlusion of host blood vessels and destruction of bone cells in both the graft and host tissues. At the flat or depressed surfaces of the graft there will be dead space filled with either air, blood clot or tissue debris produced by hammering in a misfit graft. In either instance the conditions are unfavorable as organization must take place before the blood vessels reach the graft, even if they do this resulting in either a delay or diminution of vascularization of the graft which may be fatal to the result. The old expression of a square peg in a round hole is a misfit here as in every other human endeavor and will never do. The early and complete vascularization which will occur only in an accurately fitted autogenous peg graft is not only essential to its survival but serves to carry blood and callus forming material to the anemic capital fragment and to the point of fracture.

A further most important consideration is the fact that the closer the fit the more accurate the work the less callus to secure union is necessary.

In the hip there are peculiar conditions which militate against union even in a fresh fracture regardless of the constitutional condition or age of the patient.

1. There is little or no periosteum about the head and neck of the femur.

2. The synovial fluid which tends to flow between the fragments as soon as fracture occurs has an inhibiting effect on callus formation.

I first performed this operation in 1915 and published the technique in 1919, several years before Whitman described his operation of similar nature. I still feel that it offers the best method of dealing with ununited fracture of the neck whenever erosion has produced such extensive loss of tissue of the neck that the bone graft peg cannot be applied.

It offers the following advantages: (1) It is the simplest operation yet devised and can be done in the shortest time. I have repeatedly performed this operation in 15 minutes, from the first incision to the last stitch. (2) Since the bone muscle lever displaced outward is only a shell of  $\frac{1}{4}$  inch thickness at the trochanter tip, less shortening of the limb results from this method than by any other, in fact the limb is lengthened by the operation in all cases, the exact amount varying with the existing shortening. (3) The erection of the bone muscle lever provides optimal mechanical conditions for the function of abduction and for the prevention of dislocation when the limb comes to the midline. The reconstructed upper end of the femur at the angle fills in with new bone and the lever becomes again incorporated with the shaft (Fig. 6). A case illustrating the unusual efficiency of the bone muscle lever was referred to the author some years ago by Dr. Crile.

A middle aged woman had consulted Dr. Crile, because of frequent dislocation and an entire absence of the function of abduction at the hip, following an arthroplasty for an ankylosed hip in which too much bone had been removed from the femoral head and neck. With the hip reduced a longitudinal incision was made over the trochanter and a bone muscle lever (Fig. 5) was formed. The operating time was 10 minutes. The result was excellent inasmuch as the hip never dislocated again and the function of abduction was most satisfactorily restored.

#### RESULTS

My 1927 report included a certain number of recent cases. The condition in each was described by way of an interim report. A definite opinion can now be given regarding these cases. The results in the entire group (including those reported in 1917) are set forth in Tables I and II.

It will be observed that in both groups the greatest number in any decade was between 50 and 59 and that half the patients were over 50. The bone graft peg, as might be expected, was favored over reconstruction in younger patients, but my experience has not shown that union is any less likely by this method in old age.

The time since operation was from 1 to 18



Fig. 8 Same some months later showing complete union with bone graft thoroughly consolidated with the fragments.

years. In the entire series of 228 cases the result may now be considered definite, since I have taken the reasonably conservative attitude of including no cases observed for less than one year.

Following the bone peg operation, the result was excellent in 90 per cent of cases and after the reconstruction operation excellent in 78 per cent. If to these are added those cases in which the result was fair, the percentage of favorable results becomes 97 for the bone graft operation and 90 for the reconstruction. There have been no fatal cases since 1927, so that the mortality stands at 2 cases, 2 per cent of the reconstruction cases, or  $\frac{1}{2}$  per cent of the entire series, no death having occurred in the bone peg cases.

Notes are appended to the tables indicating the causes of the unfavorable results. Failure of the patient to co-operate during the postoperative treatment and convalescence stands out as the important cause of ill success. The patient is a free agent at all times and occasionally cannot be completely controlled.

I wish to emphasize that, as the tables show, union will follow the application of the bone peg in a large percentage of cases when workmanlike methods are used with due regard to the principles of physiology and biology as well as those of mechanics (Figs. 7 and 8). The percentage in which union occurred is still higher than the 90





Fig 7 Ununited fracture of neck of femur a few weeks after operation

the severed fascia lata at the close of the operation. Then, with the wide osteotome used for splitting the spinous processes in the Pott's disease operation, the muscles are stripped down from the side of the ilium by subperiosteal separation, and are separated from one another directly downward from the anterior superior spine. The capsule of the hip joint is completely exposed. The joint is entered by a T incision with the stem running directly downward along the neck of the femur. The head of the T is made about three-fourths of an inch from the rim of the acetabulum for the purpose of furnishing a cuff of capsule to act as a lining of the outer portion of the joint and for the neck to rest against when the head has been reconstructed. Care should be taken to make the incision into the capsule sufficiently spacious so that the difficulty of getting the head out of the acetabulum will be minimized. The ligamentum teres is then severed by means of a half inch osteotome thrust deep into the joint and any adhesions of the capsule to the periphery of the head are carefully separated with a scalpel.

The limb is then strongly everted by adjusting the Albee fracture table so as to make room for the delivery of the head. With two long half inch chisels or osteotomes, the head is pried out of the acetabulum, with a motion much like that used in eating with chopsticks, one osteotome is thrust into the inner and one into the outer substance

of the head, and the two are used as levers against the soft parts to pry the head out of place. As soon as the head is delivered, the patient's limb and foot should be inverted by adjustment of the table, so that the foot points directly upward. Then with the scalpel, the soft parts are severed in a straight line down on the anterior surface of the great trochanter, to admit the wide ( $1\frac{1}{2}$  inches) osteotome that is to split off the lever as indicated in Figure 4. With this and a one half inch osteotome a lever measuring about 4 inches from the tip of the trochanter, including about one sixth of the diameter of the shaft of the femur but only a shell of bone at the tip of the trochanter, is separated and pried outward producing a greenstick fracture at the lower end. The half inch osteotome is used to remove the shell from the superior tip of the trochanter with the muscle insertions. The second part of the bone incision at right angles with the first is made with the  $1\frac{1}{2}$  inch osteotome from above downward, care being taken not to separate the muscles and soft part from the bone while doing it. The last step is to fracture the bone muscle lever outward at its extreme lower end by using the wide osteotome before its removal as a lever (Fig 5). Fragments of cancellous bone removed from the cut surface of the trochanter and shaft by means of a curette, are placed in the angle of the gap thus formed (Fig 5). The stump of the neck is then rounded so as to cause minimal irritation of the acetabulum. The assistant is directed to adjust the table so that the limb is brought to the limit of physiological abduction at the hip, and at the same time the upper end of the femur is lifted forward and guided into the acetabulum. Thus the bone lever is automatically held by the posture in the position shown in Figure 5.

The bone lever is pulled anteriorly and held with medium Kangaroo sutures in surrounding attached soft tissues. The wound is now ready for closure. All dead spaces are overcome by means of continuous suture of No. 1 chromic catgut. The skin is closed by continuous suture of No. 0 plain catgut. The line of incision and the suture holes are puddled with tincture of iodine, 3.5 per cent. The leg is put up in a long spica, extending from the tips of the toes to well above the costal margin, with the abducted position undisturbed. The plaster is molded so as to hold the upper end of the femur anteriorly and is kept on for a period of 7 weeks. The leg is then allowed gradually to resume the normal position. Patient is persuaded to begin walking with crutches immediately, and daily massage and manipulation, at hip and knee, are at once instituted.

materially reduced. If union fails and operative measures are carried out as early as possible and before serious erosion has occurred, the bone peg operation will be found feasible in practically all cases.

There are still too many cases in which faulty treatment of the original fracture hasty conclusion as to the establishment of union, too early permission of locomotion, and delay on the part of the patient produce conditions that compel recourse to arthroplasty or reconstruction.

#### SUMMARY

1 In the event of failure of union in a fresh fracture of the neck of the femur following the Whitman method the problem no longer remains a purely mechanical one, and therefore the insertion of foreign bodies in the form of boiled bone, nails, or screws is not indicated.

2 Because of inadequate blood supply not only does callus fail to form but the neck of the femur melts away. The principal indication, therefore, is to bring blood not only to the anæmic femoral neck and head but to the point of fracture.

This is best accomplished by the cabinet maker fitted autogenous bone graft peg.

3 The active osteogenesis associated with fresh fractures has subsided. In this respect, therefore, the indication is to supply an element capable of osteogenesis on its own behalf and thus the autogenous bone graft peg does.

4 The survival of the graft, both as a vessel conducting scaffold and as a callus forming element, depends largely upon complete immobilization of it in both fragments but also of each fragment with the other. Mechanically the machine fitted peg graft fulfills this requirement in the superlative degree, at the same time that metabolism being stimulated by withstanding stress because of Wolff's law.

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TABLE I—END RESULTS IN ONE HUNDRED SIXTEEN CASES TREATED BY AUTOGENOUS BONE GRAFT PEG

Age at operation, in years	Cases
0-10 years	2
10-20 years	11
20-30 years	16
30-40 years	22
40-50 years	38
50-60 years	27
Years since operation	
1- 1½	30
2- 4	41
5-10	36
10-12	9
Results	
Excellent	104
Per cent	90
Fair	9*
Per cent	7
Poor	3†
Per cent	3
Death	6

\*In three cases the result was impaired by arthritis in one the peg broke and reunited and in one motion was unduly limited

†In both the peg broke in one case due to failure of co operation and excessive weight of the patient. One patient refused further treatment. The second returned for reconstruction 2 years later with ultimate excellent result (Table II)

per cent in which an excellent result was obtained. The graft always united and in only 2 cases did it break and fail to unite.

Too much emphasis cannot be placed upon the importance of postoperative surveillance and care, particularly as to frequent X ray studies of the graft and the filling in of the fracture hiatus with well consolidated callus. Stereoscopic exposures taken in different planes are necessary. Great care must be taken not to allow weight bearing until firm union is shown.

I feel constrained to take issue with the statement that the autogenous bone graft operation requires two operative teams. My average time for taking a graft from the tibia and shaping it into a peg is 6 minutes. Such delay is not of serious moment, but the increased risk of infection and the confusion of surgeons and nurses about a patient, when two teams are working do not make for good surgery. In my opinion, such methods are to be condemned on the old fashioned principle of the cooks and the broth. Presumably it is shock that is feared but I have not found this a serious consideration, as the absence of mortality due to this operation shows.

It was my expectation, after my study in 1927, to employ the bone peg operation and the recon-

TABLE II—END RESULTS IN ONE HUNDRED TWELVE CASES TREATED BY AUTHOR'S PARTIAL ARTHROPLASTY OR RECONSTRUCTION OPERATION

Age at operation in years	Cases
0-10	1
10-20	4
20-30	9
30-40	27
40-50	37
50-60	34
Years since operation	
1- 1½	31
2- 4	40
5-14	32
Results	
Excellent	87*
Per cent	78
Fair	14
Per cent	12
Poor	9†
Per cent	8
Death	2‡
Per cent	2

\*Including case referred to in footnote in Table I

†One case was complicated by malignant disease in two cases patient did not co-operate in postoperative treatment in two cases although union was present pain persisted associated in one with flattening of the head

‡In both cases within one week of operation in one from chronic nephritis

struction operation about equally. My recent statistics show that since then I have performed the bone peg operation in more than 50 per cent of the cases.

The choice of operation is determined by the condition of the fragments and this depends on the previous treatment of the case as well as on the co operation of the patient in that treatment. In many border line cases the choice of operation cannot be determined until the head and neck of the femur have been exposed. In some instances, the capital fragment may appear in the X ray picture to be sufficiently long to receive satisfactorily a peg graft but upon exposure the fractured end will be found to have undergone erosion by excavation and the head to be a mere shell. The principal causes of this condition are undoubtedly inadequate blood supply plus unwarranted locomotion. In a few other cases I have found much connective tissue both about the periphery of and in the joint resulting in limitation or absence of motion of the head in the acetabulum. In the event of any of these conditions being found, the arthroplastic operation rather than the graft peg is chosen. If all cases of fresh fracture are treated with alertness and skill the number requiring either operation will be

Phenolsulphonephthalein test was made and the dye appeared in the urine in 5 minutes. The output was

	Per cent
First 30 minutes	25
Second 30 minutes	20
Third 30 minutes	15
Fourth 30 minutes	10
Total 2 hours	70

Guinea pig test showed the bladder and the right and left kidneys negative for tuberculosis.

Röntgen ray examination was negative for stone. A large amount of gas was seen in the colon and there seemed to be a mesial displacement of the colon on the right side.

A pyelogram of the right kidney taken July 17, 1928 showed a rounded soft parts shadow filling the right side of the abdomen from ribs to iliac crest deviating the ascending colon to the left. The right catheter curved outward to the lateral margin of the abdomen and upward to the costal border. The right pyelogram lay close to the lateral margin of the abdomen at the level of the second lumbar. The pyelogram was rotated so that kidney pelvis pointed laterally and the calyces mesially except the superior calyx which was long and narrow and curved upward and outward to the tenth intercostal space. Other calyces and kidney pelvis were normal (Fig. 1).

The left catheter was in normal position.

Blood Wassermann test was negative. Blood chemistry examination showed Urea 21.8, uric acid 3.0, creatinin 1.5, non protein nitrogen 45.5.

Urinanalysis July 18, 1928 showed albumin and 3500 leucocytes per cubic millimeter.

Temperature July 18, 1928 was 104 degrees.

Operation was performed July 18, 1928 under ethylene anesthesia. The usual oblique kidney incision was made through the skin, fascia and muscles. A tumor mass was exposed which fluctuated and was about the size described in the physical examination. This mass was located behind the peritoneum and behind and below the right kidney extending upward to the diaphragm and downward below the iliac crest medially to the vertebral column.

The right kidney was in front of and rested on this tumor. The right kidney was freed from the swelling and surrounding tissue and found to be distinctly separate from this mass. A trocar was introduced into the tumor mass and purulent fluid obtained which had the odor of urine. About 3 pints of fluid were aspirated at which point the patient suddenly went into collapse. The sac was sewed into the incision, a drain inserted and the usual closure was made.

The temperature became normal on the fourth day after operation but gradually rose again reaching 103 degrees the patient being extremely ill. Many cystoscopic examinations were made and each time two normal looking ureters in normal positions were seen. There was no sign of an accessory ureter.

Further roentgen ray studies were made on July 26, 1928. The patient was cystoscoped both ureters were catheterized and double pyelograms were made. After the ureters were catheterized and while the right ureteral catheter was being injected with bromide solution bromide solution was injected into the rubber drainage tube that led into the infected hydronephrotic sac.

Examination of the films showed the following: on the left side the pyelogram was normal and the ureter was in its normal course (Fig. 3). On the right side were seen two pelvis. The normal one was obtained by injecting the

TABLE OF AGES

	Cases
9 months	1
10 to 19 years	1
20 to 29 years	10
30 to 39 years	5
40 to 49 years	2
50 to 59 years	2
60 to 69 years	2
Not stated	7
Total	30

bromide solution into the right ureteral catheter. The second pyelogram obtained by injecting the bromide solution into the drainage tube showed a large hydronephrotic sac and a large dilated ureter that could be followed as far as the brim of the pelvis (Fig. 4).

A second operation was done September 7, 1928 under ethylene anesthesia. The previous incision was reopened and the muscles separated. Dissection was carried around the large hydronephrotic sac. The ureter came into view was followed down to the brim of the pelvis at which point it was as large as my thumb then ligated cut and carbolic acid. The hydronephrotic sac and ureter were removed and the cavity packed with iodoform gauze because of oozing.

September 22, 1928. Our records show that enormous amounts of thin straw colored fluid were seen in the wound and on the dressings. This discharge was probably urine. Patient was given some methylene blue capsules and blue fluid was discharged from the wound. It was therefore assumed that the patient had an injury to the ureter of the corresponding kidney on the right side. The discharge of urine continued on this side. The patient later developed severe pain in the right side swelling chills and fever. A diagnosis of infected kidney on the right side was made and nephrectomy advised. This advice was not heeded by the patient until January 7, 1929 at which time a second right nephrectomy was done. The kidney was very much enlarged with many adhesions around it and here and there abscesses were seen in the kidney substance. The pelvis was hydronephrotic and the entire wound showed the presence of an enormous amount of scar tissue. Convalescence was uneventful.

#### TYPE OF CASES REPORTED

An analysis of the 30 cases showed that 21 were clinical cases, 8 were discovered at autopsy, that is, during the performance of an autopsy this renal anomaly was found and the type was not mentioned in one. Of the clinical cases 2 died after operation, one in 8 days and the other in 2 months. Autopsies were performed. Many of the early autopsy cases unfortunately, are not reported in detail so that much valuable information is lacking, hence they are of doubtful value for statistical purposes.

#### AGE

In 7 cases the age was not mentioned. The youngest case reported was 9 months old (Pick quoted by Neckarsulmer) and the oldest 67 years (Cobb and Giddings). A review of the table of ages reveals rather striking facts in that the

## SUPERNUMERARY KIDNEY

REPORT OF A CASE WITH REVIEW OF THE LITERATURE<sup>1</sup>

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From The Presbyterian Hospital

THAT true supernumerary kidney is probably the rarest of the congenital renal anomalies seems to be the uniform opinion of clinicians as well as of the authors of various textbooks. Congenital anomalies are being recognized in a much greater number of instances today than formerly, thanks to the widespread, careful urological study with modern diagnostic methods, and the result is an extensive literature dealing with the various congenital anomalies of the kidney.

Although the literature on congenital anomalies is extensive the actual number of cases of true supernumerary kidney reported is exceedingly small. As a matter of fact, a review of the literature has revealed only 29 cases and this number with the case presented in this paper brings the number available for study up to 30. No doubt, this may not represent all the cases that have been reported, a few may have been overlooked for a great deal of confusion exists in the literature today as a result of carelessness in selecting titles for case reports. Thus for example we find reports of accessory kidneys and supernumerary kidneys which are really double kidneys; in a few instances horse shoe kidney has been reported as supernumerary kidney and some of the older descriptions of four kidneys would indicate horse shoe kidneys. Moreover, some cases of supernumerary kidney have been found in articles the titles of which would not suggest this rare anomaly.

True supernumerary kidneys are by no means of recent discovery. Blasius writing upon this subject in 1677 quotes Martius who in 1656 described a human subject having two kidneys on one side and a single kidney on the other. The kidneys were of the usual structure and form. However the kidneys on the side having two were smaller than normal. Each had its separate blood vessels branching from the aorta and vena cava and each its separate ureter. Hyrtl reported a case of true third kidney in 1841. Although he says the cases of four and five kidneys mentioned by the ancient authors are not all authentic, nevertheless he cites references to cases in which four and five kidneys were found.

A brief historical review is to be found in the articles by Rayer and also by Voigtel.

This condition is not limited to the human. Pieth, an inspector of butcher's meat, found a third kidney in the iliac region in a fat cow.

Several years ago I reported a case of true supernumerary kidney and I now wish to add a second case of this rare and interesting anomaly.

## CASE REPORT

Mrs H. I., aged 23 years, referred by Dr R. Drostensfels was admitted to the Presbyterian Hospital on July 16, 1928. About a week ago she began to have severe pain in the region of the right kidney. The pain was so excruciating that she could not keep from weeping. It bore no relation to eating, deep breathing, urination or bowel movements. It radiated down the right side to the bladder region. There was some tenderness just below the right costal margin. Hot applications gave relief. The patient believed that the present illness followed a cold in the head at which time she had headaches, chest pains, blood tinged sputum, malaise and general body aches. For the past 7 days patient had been extremely weak, tired and fatigued. The bowels had been constipated, cathartics gave no results. Since the onset of the present illness she had been obliged to void every 10 or 15 minutes and there had been present a sharp, intermittent pain over the bladder associated with a desire to urinate. Pain was worse after urination and remained localized in this region. Associated with frequency there was burning after urination and this was located in the urethra and vagina. Since the onset of the present trouble the patient had been obliged to void several times at night and urination was associated with burning and pain over the bladder region. Chills and fever had been present for one week, the temperature reaching as high as 103 degrees.

General physical examination was negative.

Examination of the abdomen disclosed a large hard mass on the right side which extended to the left of the umbilicus upward under the arch of the ribs and downward about one fingerbreadth below the anterior superior spine. The tumor was smooth, quite tender and did not move on inspiration.

Cystoscopic examination was made July 17, 1928. Clear sparkling urine was obtained leading one to suspect a block on the right side. Right and left ureteral orifices were normal and there was no accessory or ectopic orifice seen. Both ureters were catheterized without difficulty or obstruction. Urine obtained at this examination showed the following:

	Leucocytes per cu. mm.	micrococci	fungi	Tubercle bacilli
Bladder	2	No organisms	Sterile	None
Right kidney	160	No organisms	Sterile	None
Left kidney	80	No organisms	Sterile	None

SUPERNUMERARY KIDNEYS

Pathology in accessory kidney	Pathology in other kidney	Duration of symptoms	Symptoms	Palpable tumor	Pre-operative diagnosis	Operation	Result
Pituitary	Pituitary	3 months	Attacks of pain in epigastric region vomiting	Yes	Nephroptosis and palpable abdominal kidney	Nephrectomy in both left kidneys	Pain disappeared
Not given	Not given	Not given	Not given	Yes	Supernumerary kidney	None	
Distinctly lobulated	None	Some time	Abdominal pain in digestion and hysterical condition with severe paroxysms in quantity of urine	Yes	Movable kidney (?)	Exploratory only	Cure
Rudimentary on section no differentiation into cortical and medullary substance	Fetal kidney not functioning						
Papillary cystadenoma	None	2 years	Sudden severe pain followed by weakness Tumor palpable when bladder was full	Yes	Tumor probably pancreatic cyst	Complete removal of growth	Good recovery
Malpighian glomeruli less than normal	Increased in size situated lower than normal	4 years	Lancinating pain at level of stomach	Yes	Tuberculous enlargement of the mesentery	1. Accessory kidney engaged into the peritoneal section 2. Decapsulation 3. Suture	1. Recurrence of pain increase in size of kidney 2. Painful symptoms diminished but did not completely disappear
Not given	Normal	Not given	Not given	Not given	None	None	
Pyonephrosis	Normal	4 months	Burning sensation in extrastrangury	Yes	Division of ureter with two renal pelvises one pyonephrotically diseased	Nephrectomy	Normal recovery until eighth day Collapse death
Small but normal structure	Large pyonephrotic kidney		Pain in left kidney with pyuria Subtotal hysterectomy with removal of intraligamentary dermoid cyst After 3 weeks unattended recovery of painless micturition with retention in the kidney	Dermoid cyst, not kidney	None	Nephrectomy	Recovery

## SUMMARY OF THIRTY CASES OF

Case No	Author	Type of case	Age	Sex	Side	Location	Course of ureter	Cystoscopic examination
1	Blount				R	Below other kidney	Independent	
2	Calabrese	Clinical	55	F	I	Directly below left kidney	Not determined	Showed only 1 ureteral opening into bladder
3	Camisha	Clinical		F	R	Near vertebral column at level of crest of innominate bones	Not fused	Two orifices in bladder & a third in vulva in proximity of urinary meatus
4	Cheyne	Clinical	22	F	R	Behind the peritoneum resting on the right side of the lower lumbar vertebrae and behind of pelvis	Not fused	None
5	Clifford	Autopsy Death from pulmonary tuberculosis		M	R	Two kidneys but only 1 at so close apposition to vertebral column opposite junction of second and third lumbar vertebrae	Ureter of smaller end in blind sac beneath meso of bladder between ureteral and urethral openings	None
6	Cobb and Cuddings	Clinical	67	M	L	R retroperitoneal Behind the inferior vena cava	Ureter not found	None
7	Depage	Clinical	20	F	R	In front of vertebral column between the aorta and vena cava	Course not determined	None given
8	Dixon	Autopsy	45	M	L	Below usual kidney properly in left iliac fossa partly on quadratus lumborum muscle	Passed upward to join ureter of upper kidney	None
9	Fischer and Rothenbach	Clinical (Autopsy)	64	M	R	Below usual kidney which was high	Medial from regular ureter was an enlarged ureter course spiral entered bladder in a fold of mucous membrane immediately above right ureteral orifice. Opening very small	Right ureteral orifice slightly above left normal
10	Gay	Clinical	21	F	L	Below usual kidney	Not traced	Two openings on left 15 cm. apart similar arrangement on right

## SUPERNUMERARY KIDNEYS

Palpability in accessory kidney	Palpability in other kidney	Duration of symptoms	Symptoms	Painful tumor	Previous operations	Operation	Result
Present	Present	3 months	Attacks of pain in epigastric region vomiting	Yes	Nephrectomy and removal of accessory kidney	Nephrectomy in both kidneys	Pain has ceased.
Not given	Not given	Not given	Not given	Yes	Supra-umbilic kidney	None	
Directly below aorta	None	Some time	A formal and indigestion and hysterical condition with severe pain disturbance in quantity of urine	Yes	Accessory kidney?	Exploratory only	Cure.
Redimentary, no section no difference in cortical and medullary substance	Feet kidney not functioning						
Pillular cystadenoma	None	3 years	When severe pain followed by weakness of bladder was felt	Yes	Tumor possibly pancreatic cyst	Complete removal of growth	Good recovery
Much less growth than normal	Increased in size estimated lower than normal	3 years	Intermittent pain at level of aorta arch	Yes	Tumor in sigmoid mesentery	Accessory kidney dissected out the pelvic section. Dissection of tumor	1. Recurrence of pain increase in size of kidney painful cyst on pressure. Painful symptoms diminished but do not completely disappear
Not given	Normal	Not given	Not given	Not given	None	None	
Pyonephrosis	Normal	4 months	Bladder sensation and other strangury	Yes	Dissection of uterus with two renal pelvis, one pyonephrotically diseased	Nephrectomy	Normal recovery until ninth day. Collapse death.
Small but normal in structure	Large pyonephrotic kidney		Pain in left kidney with pyuria. Subtotal hysterectomy with removal of uterine ligaments and of uterine cyst. After 3 weeks interrupted recovery sudden pain in lower part of abdomen with tenderness in the kidney	Detached cyst, not kidney	None	Nephrectomy	Recovery



## SUMMARY OF THIRTY CASES OF

Case No.	Author	Type of case	Age	Sex	Side	Location	Course of ureter	Cystoscopic examination
1	Blasius				R	Below other kidney	Independent	
2	Calabrese	Clinical	55	F	L	Directly below left kidney	Not determined	Showed only 2 ureteral openings into bladder
3	Camilla	Clinical		F	R	Near vertebral column, at level of crest of iliac bone	Not fused	Two orifices in bladder a third in vulva in proximity of urinary meatus
4	Chapman	Clinical	22	F	R	Behind the peritoneum resting on the right side of the lower lumbar vertebrae and basin of pelvis	Not traced	None
5	Clifford	Autopsy Death from pulmonary tuberculosis		M	R	Two kidneys buried in fat in close apposition to vertebral column opposite junction of second and third lumbar vertebrae	Ureter of smaller ends in blind sac beneath mucous membrane of bladder between ureteral and urethral openings	None
6	Cobb and Goldings	Clinical	67	M	L	Retroperitoneal Behind the inferior vena cava	Ureter not found	None
7	Depage	Clinical	30	F	R	In front of vertebral column between the aorta and vena cava	Course not determined	None given
8	Dixon	Autopsy	45	M	L	Below usual kidney partly in iliac fossa partly on quadratus lumborum muscle	Passed upward to junction of upper kidney	None
9	Fischer and Rosenknecht	Clinical (autopsy)	64	M	R	Below usual kidney which was high	Deflected from regular course, ureter was an enlarged ureter, coarse, spiral, entered bladder in a fold of mucous membrane immediately above right ureteral orifice. Opening very small.	Right ureteral orifice slightly swollen left normal
10	Gayet	Clinical	2	F	L	Below usual kidney	Not traced	Two openings on left 35 cm apart similar arrangement on right

## SUPERNUMERARY KIDNEYS—Continued

Pathology in accessory kidney	Pathology in other kidney	Duration of symptoms	Symptoms	Palpable tumor	Pre-operative diagnosis	Operation	Result
Extremely disorganized by chronic inflammation and fibrosis and secondary pyogenic infection	None noted	20 months	Attacks of pain nausea vomiting	Yes	None	Nephrectomy	Eventual cure
None	Not given	Not given	Not given	Not given	None	None	
None	Smaller and lower than normal	21 years	Painful attacks at 2 year intervals accompanied by bilious vomiting General weakness for 6 months Weight and pain in abdomen accentuated after eating and fatigue Obstinate constipation	Yes	Mesenteric tumor	Proctocolon replaced	Cure
Pyonephrosis	Posterior surface in upper portion showed a shallow impression due to pressure of the accessory organ	2 years	1 Pain in bladder 2 Suppurative discharge from vagina Left kidney painful 3 Vaginal cyst 4 Fever 5 Persistent discharge from lumbar fistula	Yes	1 Suppurative pyelonephritis 2 Third kidney	1 Organ regarded as left kidney opened and drained 2 Nephrectomy	1 Alternating purulent discharge from vagina and lumbar fistula 2 Eventual recovery
Calculus Small	Calculus	2 years	Recurring attacks of kidney stone colic associated with nausea and vomiting Stones passed Pain and burning sensation Tenderness to palpation Urine blood during last month	None	Crystallization of renal pelvis	Ureter and supernumerary kidney removed	Cured
Small kidney with a cyst upon the convex edge	None	4 months	Tumor rapidly increasing in size	Yes	Tumor or cyst of right kidney	Nephrectomy	Recovery
Somewhat smaller than normal			Uncomfortable and sometimes painful feeling in left lower abdomen	Yes	Dermoid cyst of ovary and pregnancy	Nephrectomy	Smooth recovery
None	None	3 years	Pain in left abdomen	Yes	Retropertoneal tumor	1 Exploratory 2 Nephrectomy	Cure
Small and undeveloped							
None	Calculus in pelvis of left kidney Right lower than normal	8 years	Pain in left lumbar region at angury Frequent micturition cloudy urine	None	Calculus of left kidney	Calculus removed by pyelotomy	Cure
Rudimentary Small calculus	Calculus		Right renal colic hematuria purulent urine Gravel passed	None	Calculus	Calculus removed Nephrotomy	Cure

## SUMMARY OF THIRTY CASES OF

Case No.	Author	Type of case	Age	Sex	Side	Location	Course of ureter	Cystoscopic examination
11	Himes	Clinical	10	F	R	Almost transverse over brim of pelvis close to perineum	Ureter divided into several branches near kidney with separate implantations on surface	None
12	Hyrtl	Anatomy	Middle aged	F	L	At entrance to true pelvis to left, on sacrotubular symphysis behind broad ligament	Beside usual ureter to fundus of bladder Not fused	Alone inward from side of usual ureter
13	Isaacs	Clinical	25	F	R	To right of external iliac artery	Fused with usual ureter 5 cm from supernumerary kidney	Two ureters in normal site
14	Israel	Clinical	12	F	L	Partly above and behind left kidney which was slightly lower than usual position	Not fused	Two ureters entered bladder at normal points. Third orifice not found, probably in cyst of vagina
15	Kretschmer	Clinical	17	F	L	Below	Ureter fused with that of normal kidney outside bladder	Small polyp on internal orifice of ectopic Micropus Two lateral orifices only
16	Kukunaja	Clinical	45	F	R	Adjacent to adipose capsule of usual kidney	Not traced	Two normal ureteral orifices
17	Leberstedt	Clinical	10	F	L	At the level of the bifurcation of the abdominal aorta	Indefinite ureter	None given
18	Linberg	Clinical	26	M	L	Immediately above left common iliac artery on the psoas major	Fused Five canaliculi 1 cm accessory kidney joined normal ureter	Two orifices, normal location
19	Mangeti	Anatomy		M	L	Above the normal kidney	Ureter lacking	
20	Maslovitch	Clinical	30	M	L	In true pelvis with uterus turned upward	Fused with ureter of usual kidney just before reaching bladder	Two normal orifices
21	McArthur	Clinical	Middle aged	M	R	Above the iliac crest	Fused with usual ureter 2 inches below usual kidney	None

## SUPERNUMERARY KIDNEYS--Continued

Patient in cessor kidney	Patient in thoracic kidney	Duration of symptoms	Symptoms	Palpable tumor	Pre-operative diagnosis	Operation	Result
Hydronephrosis of left kidney with trophic changes and hypertrophy	Normal	20 years 4 months	Indigestion abdominal pain vomit & fever Headache feeling of malaise constant dull bearing of weight on pelvis over bladder	Yes Yes	None Not given	1 Aspiration of cyst like tumor It was opened and packed with iodine gauze 2 Cyst removed	1 Discharging sinus 2 Recovery
Healthy left kidney	Not given	Not given	Not given				
Embryologic	Right kidney normal Left kidney 2 cm lower than right how acute changes due to infection from mesonephros	Not given	Acute nephritis	None			
Abcess in right kidney with dilated pelvis and concretions	Abcess under capsule of right kidney which dilated and filled with pus and concretions Left kidney pelvis dilated and filled with pus and concretions	3 months	Pruritus emaciation constipation secrete pus in urine	No	Cystitis following bullet wound Suppurative nephritis	Nephrectomy	Improvement for 2 months Return of previous symptoms plus vomiting diarrhea & hematuria Urinary fistula opened Death
Dysuria with pyuria	Normal	A far back cannot remember	Vaginal leakage of urine 16 years previous unsuccessful plastic operation for vaginal prolapse	No	Spermatozoa in urine with hydroureter opening to vagina	Nephrectomy	Cure
Minor Not true hydronephrosis	Unusually large	Not given	Not given	Not given			
None	No	No	Not given	Not given			
None	Small thin kidney on right	Not given	Not given	Not given			
Infected hydronephrosis with infection	Normal		Pain on vomiting chills and fever	Yes	Pyelonephritis	Two nephrectomies	Cure

## SUMMARY OF THIRTY CASES OF

Case No	Author	Type of case	Age	Sex	Side	Location	Course of ureter	Cystoscopic examination
22	Munro and Goddard	Clinical	23	M	I	Entirely within the peritoneum close beneath the median line, somewhat to left	Passed to bladder apparently at the fundus	Careful search for proximal ureter at stump proved fruitless
23	Newman	Autopsy (death from malignant disease of ascending colon)	Adult	M	L	Close to upper margin of usual kidney	Fused with left ureter half an inch below pelvis of left kidney	
24	Pick (Neckarsulzer)	Autopsy (death from measles and pneumonia)	9 mo	F	L	On upper pole of left kidney	Parallel to other ureter ending blindly in bladder in medial direction from but very near left ureteral orifice	None
25	Rutshinsky	Clinical (autopsy)	25	M	L	Below normally located kidney	Not traced	(Autopsy). Two ureteral orifices
26	Samuels, Kern and Sachs	Clinical	9	F	R	At upper pole of right kidney	Passed posterior to blood vessels and pelvis of usual kidney. Orifice in anterior wall of vagina	Urethral and ureteral orifices normal
27	Marine Hospital Reports (see Reference No. 27)	Autopsy (death from exhaustion due to laryngitis and phthisis)	10	M	L	In hilum of left kidney	Pelvic for 2.5 cm from pelvis	None
28	London Medical Gazette (see Reference No. 28)	Autopsy (death from typhus fever)	30	M	R	On right iliac artery and the psoas muscle	Right ureter passed down as far as the bifurcation of the aorta to the third kidney. It passed through a longitudinal sinus in the supernumerary kidney and joined the ureter of the latter	None
29	Von Hansemann	Autopsy (death from perforated ulcer of the stomach)	27	M	L	Below usual kidney	Fused with usual ureter	None
30	Kretschmer (Case reported in this paper)	Clinical	22	F	R	Behind the other right kidney	Fused with the other ureter outside the bladder	Two normal ureters orifices

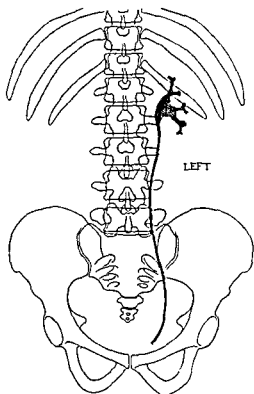


Fig. 3. Left pyelogram kidney pelvis and ureter are normal

cystoscopic picture is normal in this respect the reason this anomaly is not recognized is quite apparent

The cases reported were studied to ascertain whether or not this course of the ureters was the rule that is whether the two ureters on the side of the supernumerary kidney fused outside the bladder so that only two ureteral orifices were found in the bladder. Unfortunately in some of the case reports this phase of the question was not discussed and data were not available on this point. Nevertheless for the purpose of discussion the cases may be divided into four groups.

In Group 1 the course of the ureter could not be or was not traced so that information on this point was lacking.

In Group 2 the supernumerary ureter fused with the normal ureter. The fusion occurred anywhere along the course of the ureter with the result that two normal ureteral openings were found in the bladder on cystoscopic examination or at autopsy. Cases belonging to this group were reported by Dixon, Isaya, Kretschmer (2 cases), Linberg (Fig. 6), Maximovitch, McArthur,

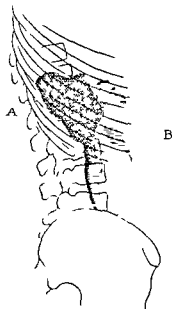


Fig. 4. Lateral view of the right side showing (a) a large hydronephrotic kidney and (b) the pyelogram of the normal kidney on the corresponding side

Newman, London and von Hanseemann, and in the *London Medical Gazette*.

In Group 3 the ureters did not fuse outside the bladder so that there were three separate ureteral orifices. The location of the supernumerary ureteral orifice in the bladder varied greatly, above the right ureteral orifice (Fischer and Rosenlocher) in the fundus of the bladder (Hyrtl). In Clifford's case two of the three kidneys were rudimentary. Two ureters evidently had a normal termination in the bladder and the third ended in a blind sac beneath the mucous membrane of the bladder between the ureteral and the urethral openings. Insertion of the supernumerary ureter may be vesical or extravascular, that is ectopic as occurred in Camina's case in which the ureteral opening was found alongside the external urethral orifice, termination of the ureter in a cyst of the vagina was reported by

#### COURSE OF URETER

	Cases
Fused	11
Not fused	8
Not determined	7
Independent	1
Blind sac	1
Ureter lacking	1
Not clearly stated	1
Total	30



Fig. 1. Right pyelogram made July 17, 1928, before the first operation. Note differences in the courses of the two ureters.



Fig. 2. Right pyelogram made July 26, 1928, after drainage of the supernumerary kidney.

largest number of cases reported occurred in the second decade of life which would seem to justify the statement that this type of renal anomaly is prone to produce pathological changes in the kidney early in life.

#### SEX

A review of these 30 cases showed that 15 occurred in females, 14 in males, and in 1 case the sex was not mentioned, the incidence being about evenly divided between two sexes.

#### SIDE

With reference to the frequency with which either side is affected our series is so small that extra care should be exercised in interpreting the available data. However, in 17 the left side was affected, in 12 the right side, and in 1 case the location was not stated.

In the majority of the case reports the location was given rather accurately. In most of the cases the supernumerary kidney was found below the so-called normal kidney. The designation of the location varied from the simple term "below" to a definite anatomical description, for instance Israel says "partly above and behind the left kidney," Newman, close to the upper margin of the

left kidney. Samuels, Kern and Sacks at the upper pole of the right kidney, Marine Hospital Report in the hilum of the left kidney.

In the case which I previously reported the supernumerary kidney was well below the so-called normal kidney, and in the case here reported it was behind the so-called normal kidney and extended much higher and much lower. The reason for this was that the kidney had been completely destroyed and only a very large hydronephrotic sac was present. The exact location of the supernumerary kidney is shown in the pyelogram (Fig. 4). The relationship in this case is somewhat analogous to that in the case reported by Fischer and Rosenlocher (Fig. 5).

#### COURSE OF THE URETER

In the case which I previously reported the two ureters fused and formed a single ureter outside the bladder so that repeated cystoscopic examinations showed two normally located ureteral openings. Exactly the same anatomical condition was found in the present case on cystoscopic examinations carefully carried out. As a rule in this type of case only two ureteral orifices are found in the bladder, and because the

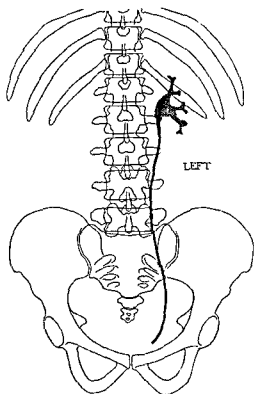


Fig 3 Left pyelogram kidney pelvis and ureter are normal

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In Group 1 the course of the ureter could not be or was not, traced so that information on this point was lacking.

In Group 2 the supernumerary ureter fused with the normal ureter. The fusion occurred anywhere along the course of the ureter with the result that two normal ureteral openings were found in the bladder on cystoscopic examination or at autopsy. Cases belonging to this group were reported by Dixon, Isaya, Kretschmer (4 cases), Linberg (Fig 6), Maximovitch, McArthur,

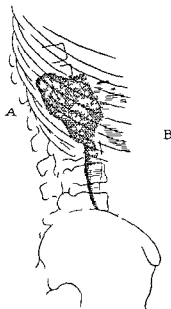


Fig 4 Lateral view of the right side showing, (a) a large hydronephrotic kidney and (b) the pyelogram of the normal kidney on the corresponding side

Newman, London and von Hansemann, and in the *London Medical Gazette*.

In Group 3 the ureters did not fuse outside the bladder so that there were three separate ureteral orifices. The location of the supernumerary ureteral orifice in the bladder varied greatly above the right ureteral orifice (Fischer and Rosenlocher) in the fundus of the bladder (Hyrtl). In Clifford's case two of the three kidneys were rudimentary. Two ureters evidently had a normal termination in the bladder and the third ended in a blind sac beneath the mucous membrane of the bladder between the ureteral and the urethral openings. Insertion of the supernumerary ureter may be vesical or extravescical, that is ectopic, as occurred in Camina's case in which the ureteral opening was found alongside the external urethral orifice. Termination of the ureter in a cyst of the vagina was reported by

#### COURSE OF URETER

Fused
Not fused
Not determined
Independent
Blind sac
Ureter lacking
Not clearly stated
Total

Cases

11

8

7

1

1

1

1

30



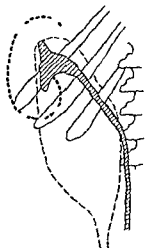


Fig. 5 Case of Fischer and Rosenlocher. Schematic representation of the pyonephrotic sac and the right kidney

Israel and in the anterior vaginal wall by Samuels Kern and Sacks

In Group 4 we have the rudimentary ureter

#### PATHOLOGY IN THE SUPERNUMERARY KIDNEY

An analysis of these 30 cases showed the presence of pathology in 19 instances. In a relatively large number of cases stone and infection were present, and they head the list as will be seen by referring to the table. Only 1 case of tumor was mentioned and curiously enough no case of renal tuberculosis is mentioned. Stones were present in 3 cases and it is interesting enough to call attention to the fact that in two of them (McArthur and Kretschmer) stones were found not only in the supernumerary kidney but in the other kidney on the same side. In the case reported by Kutschinsky all three kidneys were

#### PATHOLOGY IN THE SUPERNUMERARY KIDNEY

	Case
Stone	3
Rudimentary	3
Small but normal	3
Pyonephrosis	2
1 to 15	1
Lobulated	1
Follicular cystadenoma	1
Fibrosis with pyogenic infection	1
Cyst	1
Small and undeveloped	1
Hydronephrosis	1
Infected hydronephrosis	1
No pathology	7
Not stated	4
Total	30

the seat of stones and very severe infection. The supernumerary kidney was normal in 7 cases and in 4 cases no mention was made as to whether the supernumerary kidney was normal or not.

#### PATHOLOGY IN THE OTHER KIDNEY ON THE SIDE AFFECTED

The other kidney on the side affected was normal in 14 cases and no mention was made of pathology in 6 cases, so that pathology was present in only 10 cases. Here as in the supernumerary kidney, calculus was the condition most frequently found, having been reported in 4 of the 10 cases showing pathology.

#### PATHOLOGY IN OTHER KIDNEY ON THE SIDE AFFECTED

	Cases
Stone	4
Smaller than normal	1
Rudimentary	1
1 to 15	1
Pyonephrosis	1
Nephritic diagnosis	1
No pathology	14
Not stated	6
Total	30

In reviewing the pathology found both in the supernumerary kidney and in the other kidney interesting figures are at hand. Of the 30 cases the supernumerary kidney showed pathology in 19 cases, 7 were normal, and no mention was made of the change in 4 cases. When one directs attention to the other kidney on the affected side the number of cases in which pathology was found was 10 just about one half. The kidney was normal in 14 cases and in 6 nothing was stated about the pathology. The largest single evidence of pathology was stone which occurred in 4 of these cases. Of course it was during the operation for stone in some of these cases that the accessory kidney was found. In one case that of Rutschinsky calculi were present in all three kidneys. In the case which I previously reported there were stones in the supernumerary kidney and in the other kidney on the side affected.

The occurrence of rudimentary kidney is rare in this condition. Neckarsulmer coined the term. Beimeren to designate not the usual accessory kidney but those which he stated should be placed in a separate class, third kidneys—distinct organs which appear only in rudimentary form and are of no functional importance. The author states that these organs may be called *pararenal bodies* in the same sense as the term *parathyroid bodies* is used to designate formations in the regions of the thyroid. Besides his case he calls

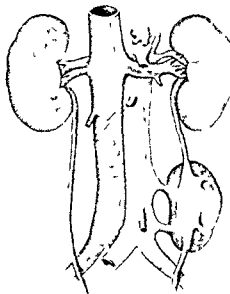


Fig. 6 Case of Inberg. Schematic representation of the position of supernumerary kidney.

attention to the case reported by Schonberg and Palma. In conclusion Neckersulmer calls attention to the differences between these rudimentary organs and the fully developed third kidneys capable of functioning. While the latter show their independent character in most cases by being entirely separated from the normal kidney of that side the rudimentary organs maintain a typographical connection with the kidney of that side. This fact, as well as their location on the upper pole in contradistinction to the separate kidneys which always lie toward the pelvis, is so constant that it might be called the rule.

In Clifford's case there were three rudimentary kidneys.

#### SYMPTOMS

**Pain.** The subjective symptoms vary depending in part of course upon the underlying pathology. Pain was present in 16 cases and seems to have been the one outstanding constant symptom but its description, duration and localization varied greatly, being described as epigastric, abdominal, renal colic and pain in the left side of the abdomen. In Calabrese's case the symptoms were of 2 weeks' duration whereas in Isava's case they were present for 21 years. Among other symptoms noted were nausea, vomiting, frequency of urination, strangury and pain in bladder.

There was nothing characteristic in the symptoms mentioned by patients to allow one to establish

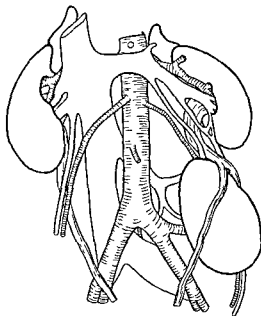


Fig. 7 Case of Dixon. Showing the occurrence of a third kidney in an adult male subject.

a diagnosis of supernumerary kidney, often the symptoms were suggestive of a kidney lesion but beyond this one could not venture a diagnosis without resorting to special methods.

#### PALPABLE TUMOR

Palpable abdominal tumor was found in 14 cases. No tumor was present in 6 cases and no mention was made on this point in 9 cases. In 1 case a swelling was palpable but, as subsequent events proved, the palpable swelling was due to a dermoid cyst and hence had nothing to do with the supernumerary kidney. In the case which I previously reported the supernumerary kidney was very small; hence, it was not palpable. In the case herewith reported a palpable tumor was present due to a very large hydronephrosis that extended from under the arch of the ribs into the right iliac fossa. That the palpable tumor in this case was due to a supernumerary kidney did not dawn upon us.

#### DIAGNOSIS

A pre-operative diagnosis was not made in many of these cases. This is easy to understand in the older cases before the present accurate methods of diagnosis were available. A pre-operative diagnosis was made by Isriel and by Samuels, Kern and Sacks.

In the group in which the kidney and its ureter are rudimentary, pre-operative diagnosis is almost

never, if ever, made. The difficulties in establishing a diagnosis in this rare type of case is, of course, self evident. Such cases in the literature were first discovered at autopsy (Clifford Mangeti, and Marine Hospital Report).

The group in which the two ureters on one side fuse outside the bladder to terminate as one ureter in a normally placed ureteral hillock presents difficulties in diagnosis in that the cystoscopic picture is that of a normal bladder with two ureteral orifices. If a pyelogram is made with the catheter low down a picture of both kidneys may be obtained and a positive diagnosis made.

In the case herewith reported the pre operative diagnosis rested between perinephritic abscess and carbuncle of the kidney. The diagnosis of three kidneys was made at the time of the first operation and was verified by an injection into the drainage tube in the loin with a simultaneous pyelogram, which showed the pelvis of the normal kidney as well as the large hydronephrotic sac of the supernumerary kidney.

In the third group in which the ureters do not fuse and the three ureters are seen in the bladder or in which they terminate extravasically, a clue to the diagnosis is at hand and may be verified by pyelograms. In this group, of course, it is necessary to differentiate between supernumerary kidney and double kidney with an accessory ureter.

#### TREATMENT

Treatment must of course vary depending upon the location of the disease and especially on the type of disease. If, for example, the lesion is in the kidney on the same side then the supernumerary kidney may be left *in situ*. When the lesion occurs in the kidney on the same side there are good grounds to suspect the presence of a supernumerary kidney. This happened in several of the reported cases.

The following surgical operations have been performed.

#### TABLE OF OPERATIONS

	(a)
No operation	11
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Nephropexy and nephrectomy	1
Exploratory only	1
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Removal of tumor	1
Total	30

#### SUMMARY

- 1 The primary lesion in the case reported in this paper was a very large infected hydronephrosis.
- 2 There was no communication between the two kidneys, each had a separate blood supply and a separate ureter that fused below the brim of the pelvis and outside the bladder.
- 3 The two kidneys on the right side were removed.
- 4 The total number of cases reported to date including this case is 30.

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## A LARGE CYSTIC MYOMA SITUATED IN THE LEFT BROAD LIGAMENT AND ALMOST COMPLETELY SEPARATED FROM THE UTERUS

FRANCIS H LANGLEY M D BALTIMORE MARYLAND

Reside 1519 on Hospital for Women of Maryland

CYSTIC myomata similar to the one to be described are exceptionally rare Kelly and Cullen in a review of over 1 600 myomata seen by them did not encounter a similar case and in going through the literature I found only 4 such cases Janicot and A L Smith described large myomatous tumors with a distinct connection still existing between the growth and the uterus Eden and A J Smith found only a few strands of tissue between the two structures

The similarity between the various growths described was marked All the myomata were within the broad ligaments The tumors were large and two (4 5) had dissected the peritoneum free from the posterior surface of the uterus right across into the broad ligament of the opposite side It is of interest to note that in all 4 cases the growth had arisen on the left side In every case the intraligamentary position of the myoma simplified removal because the tumor could be shelled out with little bleeding and without danger to the ureter

The tumors consisted largely of multiple cysts together with small masses of myomatous and fibrous tissue Even the densest parts contained small cysts some being microscopic in size All stages of change from muscle and fibrous tissue through hyaline degeneration to the clear fluid of the cysts were noted Janicot claimed that one cavity was lined with endothelium but no one else found any sign of a lining membrane in the cavities In each case there still remained some connection between the myoma and the myometrium In spite of this both Eden and

A J Smith made the definite assertion that the myomata had sprung from smooth muscle fibers normally present in the broad ligaments

In Eden's case death occurred 33 days after operation from some ill defined pulmonary condition The other patients made uneventful recoveries

Mrs S B aged 43 white consulted Dr Thomas S Cullen on September 19 1928 Her periods had been regular and painless She had had one child For 5 years she had had a disagreeable feeling in the left lower abdomen On examination some tenderness was noted in the appendix region and the patient complained of a gnawing sensation in the left lower abdomen The outlet was normal the cervix back and the body of the uterus normal in size The left side of the pelvis was filled with what appeared to be a cystic tumor This also occupied the lower portion of the left side of the abdomen

Operation Homin's Hospital September 24 1928 As soon as Dr Cullen had opened the abdomen it was perfectly clear that there was an intraligamentary tumor on the left side as there were two series of blood vessels The broad ligament peritoneum was split and the tumor shelled out There was very little bleeding and a large hole was left in the broad ligament There was some oozing down near the left uterine artery It was necessary to dissect out the left ureter after which the four or five bleeding points were readily controlled The broad ligament was then closed There was a myoma about 2 centimeters in diameter far down on the posterior surface of the uterus It was not disturbed Both tubes and ovaries were normal The appendix was looped on itself and adherent It had evidently given rise to considerable trouble It was removed The abdomen was closed without drainage

Following operation the patient developed a phlebitis in the left leg She had had some trouble with the outer side of this leg before operation She made a satisfactory recovery

never if ever, made. The difficulties in establishing a diagnosis in this rare type of case is, of course self evident. Such cases in the literature were all discovered at autopsy (Clifford Mangeti, and Marine Hospital Report).

The group in which the two ureters on one side fuse outside the bladder to terminate as one ureter in a normally placed ureteral hillock presents difficulties in diagnosis in that the cystoscopic picture is that of a normal bladder with two ureteral orifices. If a pyelogram is made with the catheter low down a picture of both kidneys may be obtained and a positive diagnosis made.

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Fig 4 Cyn Path No 33838 Myomatous tissue under liquefaction. In the upper part of the picture myomatous tissue is clearly seen. As we press downward the muscle cells rapidly diminish and then totally disappear. In the lower part of the field liquefaction has taken place.



Fig 5 Cyn Path No 33838 A degenerating myoma. In the upper part of the section is myomatous tissue. In the central portion is an area of liquefaction. In the lower half of the section are some muscle fibers, but the major portion of the picture consists of delicately fibrillated tissue devoid of nuclei.

Examination of the patient on November 2, 1924, showed normal pelvic structures. There was not the slightest thickening in the left broad ligament.

*Pathological report.* Cyn Path No 33838. The specimen consists of a partly solid partly cystic tumor 16 by 14 by 8 centimeters (Fig 1). It is uniformly grayish in color, is devoid of peritoneum and covering its surface are a number of fan like thin adhesions. At one point is a small pedicle about 1.5 centimeters in diameter (Fig 2). This contains two or three small blood vessels.

On section one finds a central core resembling myomatous tissue and passing from this to the outer surface of the tumor are trabeculae (Fig 3). The greater portion of the tumor in the outlying areas is cystic. The line of demarcation between the cystic areas and the solid portion is sharply defined. The cystic cavities contain yellow serous like fluid.

Sections through the central core show that it is a myoma (Fig 4). There is however a great deal of hyaline transformation so that just here and there is a muscle fiber visible. At other points the hyaline material has liquefied or has entirely disappeared leaving a fibrillated tissue (Fig 5). In some places hyaline transformation has occurred in clumps squeezing the remaining muscle fibers and producing a most unusual picture. The remain-

ing fibers look like channels of cells running in all directions. The cystic cavities noted in the outlying portions of the tumor have no cellular lining. They are due to a breaking down and liquefaction of the hyaline myomatous tissue.

We have in this case a partly cystic myoma which has in large measure become separated from the uterus and which is lying in the left broad ligament. There is not the slightest evidence of malignancy.

I want to thank Miss Elizabeth Broedel for her fine illustrations. Mr. Hermann Becker for his clear photographs. Dr. Cullen for asking me to report this unusual case.

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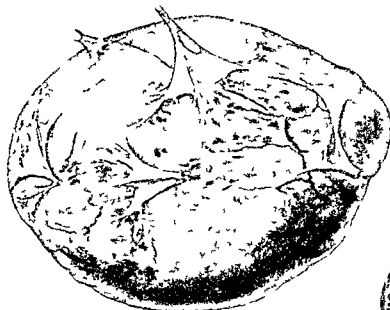


Fig. 1 Gyn. Path. No. 33838. Myoma of the broad ligament. For its pedicle see Figure 2. For its appearance on section see Figure 3.



Fig. 2 Gyn. Path. No. 33838. Myoma of the broad ligament. The pedicle is shown in the center of the picture. All that was necessary was to tie a few small vessels. The tumor had hardly any connection with the uterus.

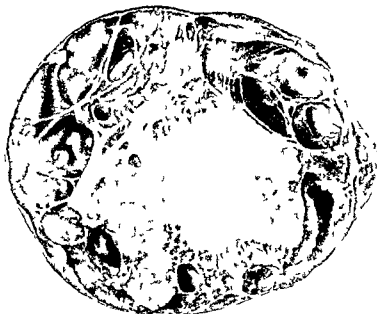


Fig. 3 Gyn. Path. 33838. A large cystic myoma which lay in the left broad ligament and had only the faintest connection with the uterus. For the appearance of the outer surface of the tumor see Figures 1 and 2. In the center is a core of typical myomatous tissue. Passing off from this toward the periphery are numerous trabeculae. The cystic spaces had no epithelial or endothelial lining. The cavities were filled with serous fluid.



Fig 4 Cyn Path No 33838 Myomatous tissue undergoing liquefaction. In the upper part of the picture myomatous tissue is clearly seen. As we pass downward the muscle cells rapidly diminish and then totally disappear. In the lower part of the field liquefaction has taken place.



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Examination of the patient on November 1, 1919, showed normal pelvic structures. There was not the slightest thickening in the left broad ligament.

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## OSTEOCHONDRITIS OF THE SYMPHYSIS PUBIS

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**O**STEOCHONDRITIS of the symphysis pubis is probably not an extremely rare condition, but it is one about which there is but scant information in the literature. Because of this lack of literature on the subject and because of the fact that in at least 3 of these 4 cases the diagnosis was overlooked for a long time by competent surgeons, we feel that it is worthwhile to bring this condition to the notice of the profession. The predominance of urinary symptoms in such patients, or the occurrence of osteochondritis as a complication of bladder surgery usually brings such cases to the urologist who is not particularly interested in bone pathology. This fact probably accounts in part for the lack of literature on the subject. Three of the cases were seen by us on the genito-urinary service of the Massachusetts General Hospital. The fourth was a private case of Dr. Arthur Chute of Boston to whom we are greatly indebted for permission to include it in this report.

Tuberculosis of the symphysis pubis and osteomyelitis of other bones of the pelvis are not infrequently referred to in the literature. Cabot refers to infection of the symphysis pubis as a possible complication of suprapubic prostatectomy. Legueu and Rochet report the occurrence of an abscess behind the pubic bone as a complication of suprapubic prostatectomy, causing in one case erosion of the pubic bone. This case they thought was due to direct infection from the urine. The only extensive works on the subject which we have been able to find are two articles by Beer. In all he reports that he has seen 12 or more cases of periostitis and osteitis of the symphysis pubis following suprapubic cystotomy. He believes that the condition is caused either by injury to the periosteum from traction on the recti muscles or by pressure from the suprapubic drainage tube. The symptoms develop 3 or 4 weeks after operation. There is usually pain when patient moves and walks due to the pull of the muscles on the diseased periosteum. On examination there is slight tenderness over the pubis. The X-ray picture of the pubis may be normal or may show various degrees of involvement of the pubic bone, from slight changes in outline to a marked destruction. As the process extends it may involve the descending ramus of the pubis. In all cases, Beer found that the condition cleared up

after simple local treatment such as the application of heat.

Two of our cases were similar to the ones reported by Beer in that they followed suprapubic prostatectomy. They differed, however in that they did not go on to a spontaneous cure. The other two did not follow an operation on the bladder. In fact, all 4 cases differed from one another in many respects. Each case, however showed signs and symptoms of a septic process involving the symphysis, which was proved to exist either at operation or at autopsy. Likewise the condition showed in every case marked chronicity which tended to obscure the diagnosis, as did also the lack of definite X-ray findings in 2 of the cases. In these 2 cases the X-rays were at first interpreted as being normal by an expert roentgenologist. The interpretation of an infectious process in this bone is very difficult, because of the wide anatomical variations in the outline of this joint. In every case the infectious process was due so far as we have been able to determine to a pyogenic organism and not to tuberculosis.

The first case (M. G. H. 271325) of osteochondritis of the symphysis pubis which we saw was in a man of 69 years. He entered the Massachusetts General Hospital on January 3, 1928 complaining of the typical symptoms of benign prostatic hypertrophy. Two days after entry a suprapubic cystostomy was done under local anesthesia. A large rubber tube was inserted into the bladder for drainage and an empty Miller wick was placed in the prevesical space. The incision was carried down unusually close to the pubic bone and the drainage was from the lower angle of the incision but so far as was known the periosteum of the pubis was not injured. Three weeks later a second stage suprapubic prostatectomy was done under ethylene anesthesia. Fifteen days later the suprapubic wound was healed the patient was voiding normally and was well enough to go home.

Two months after discharge the patient entered the emergency ward of the hospital. At this time he stated that since his discharge from the hospital his legs had felt weak and he had had a drawing sensation in the region of the pubis. Ten days before entry this sensation had changed to a severe pain in the lower abdomen which radiated down both legs. This pain was aggravated by motion and had become so severe that the patient was unable to walk. At this time he had practically no urinary symptoms.

Physical examination showed a well healed suprapubic scar at the lower end of which an indefinite mass could be felt in the prevesical space. This was tender about the size of a lemon and firmly attached to the pubic bone. The skin over this area was slightly red. Any movement of the legs was painful but compression of the crests of the ilium produced no discomfort. The urine was grossly clear but contained white blood cells on microscopic examination.



Fig 1 Roentgenogram of the first case reported. This was taken just before operation and shows only slight irregularity of the outline of the pubic symphysis which is within normal limits. At operation the cartilage was found destroyed but the bone did not appear to be involved.



Fig 2 Roentgenogram of the third case. The symphysis pubis is irregular in outline and shows disalignment with the sacrum. Areas of decreased density in the left pubic bone are not well shown in the reproduction.

The white blood count was repeated several times and was normal except on one occasion. The temperature varied between 99° and 99.8 degrees. An X-ray taken at this time showed slight irregularity of the outline of the pubic bone adjacent to the symphysis but was considered by the roentgenologist to be within normal limits. The patient was observed for 2 weeks in the hospital; the local signs subsided; his symptoms improved markedly and he was discharged without any diagnosis having been made.

On May 9, 1923, nearly 4 months after his operation, the patient returned again to the hospital. At this time his symptoms were the same as at his last entry, only not so severe. There was tenderness over the pubic bone, but no mass could be felt. He had lost some weight, but his general condition was good. The temperature and white blood count were normal, but the urine was grossly infected. Cystoscopy showed an area of granulation tissue on the roof of the bladder in the region of the old incision. This area was about 1 centimeter in diameter and a small stream of pus could be seen entering the bladder from beneath it. Accordingly a diagnosis of prevesical abscess draining into the bladder was made. The X-ray at this time (Fig 1) was the same as 2 months before and was again reported as negative.

On May 17, operation was performed. The old scar was excised; the peritoneum was freed from the bladder and the bladder was opened. The bladder was adherent to the pubic bone from which it had to be separated by sharp dissection. After this the bladder was closed. The incision was then carried down on to the pubic bone through a mass of indurated tissue. Some yellow pus escaped which on culture grew a *Graham negative bacillus*. The cartilage of the symphysis was found completely destroyed. Although the rami of the pubis were thus completely separated from each other, they did not appear involved in the process in any way. Some tissue in this region was removed for pathological examination and report of chronic inflammatory tissue was returned by the pathologist. Two cigarette drains were inserted and the wound closed in the usual manner.

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tion. This has however slowly disappeared so that at the present time, 11 months after operation, he has no pain except occasionally after very severe exertion. His general condition is good and he has gained weight.

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## OSTEOCHONDRITIS OF THE SYMPHYSIS PUBIS

EDWARD L. HILPSON, JR. M.D. SALEM, MASSACHUSETTS

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**O**STEOCHONDRITIS of the symphysis pubis is probably not an extremely rare condition, but it is one about which there is but scant information in the literature. Because of this lack of literature on the subject and because of the fact that in at least 3 of these 4 cases the diagnosis was overlooked for a long time by competent surgeons, we feel that it is worth while to bring this condition to the notice of the profession. The predominance of urinary symptoms in such patients, or the occurrence of osteochondritis as a complication of bladder surgery, usually brings such cases to the urologist who is not particularly interested in bone pathology. This fact probably accounts in part for the lack of literature on the subject. Three of the cases were seen by us on the genito-urinary service of the Massachusetts General Hospital. The fourth was a private case of Dr. Arthur Chute of Boston to whom we are greatly indebted for permission to include it in this report.

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Two of our cases were similar to the ones reported by Beer, in that they followed suprapubic prostatectomy. They differed however in that they did not go on to a spontaneous cure. The other two did not follow an operation on the bladder. In fact all 4 cases differed from one another in many respects. Each case however, showed signs and symptoms of a septic process involving the symphysis which was proved to exist either at operation or at autopsy. Likewise the condition showed in every case marked chronicity, which tended to obscure the diagnosis as did also the lack of definite X-ray findings in 2 of the cases. In these 2 cases the X-rays were at first interpreted as being normal by an expert roentgenologist. The interpretation of an infectious process in this bone is very difficult, because of the wide anatomical variations in the outline of this joint. In every case the infectious process was due so far as we have been able to determine to a pyogenic organism and not to tuberculosis.

The first case (M. G. H. 271353) of osteochondritis of the symphysis pubis which we saw was in a man of 60 years. He entered the Massachusetts General Hospital on January 3, 1918 complaining of the typical symptoms of benign prostatic hypertrophy. Two days after entry a suprapubic cystostomy was done under local anesthesia. A large rubber tube was inserted into the bladder for drainage and an empty Miller wick was placed in the prevesical space. The incision was carried down unusually close to the pubic bone and the drainage was from the lower angle of the incision but so far as was known the periosteum of the pubis was not injured. Three weeks later a second stage suprapubic prostatectomy was done under ethylene anesthesia. Fifteen days later the suprapubic wound was healed the patient was voiding normally and was well enough to go home.

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The white blood count was repeated several times and was normal except on one occasion. The temperature varied between 99.5 and 99.0 degrees. An X ray taken at this time showed slight irregularity of the outline of the pubic bone adjacent to the symphysis but was considered by the roentgenologist to be within normal limits. The patient was observed for 2 weeks in the hospital; the local signs subsided; his symptoms improved markedly and he was discharged without any diagnosis having been made.

On May 9, 1918, nearly 4 months after his operation, the patient returned again to the hospital. At this time his symptoms were the same as at his last entry, only not so severe. There was tenderness over the pubic bone, but no mass could be felt. He had lost some weight, but his general condition was good. The temperature and white blood count were normal, but the urine was grossly infected. Cystoscopy showed an area of granulation tissue on the roof of the bladder in the region of the old incision. This area was about 1 centimeter in diameter and a small stream of pus could be seen entering the bladder from beneath it. Accordingly a diagnosis of prevesical abscess draining into the bladder was made. The X ray at this time (Fig 1) was the same as 2 months before and was again reported as negative.

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tion. This has however slowly disappeared so that at the present time, 11 months after operation, he has no pain except occasionally after very severe exertion. His general condition is good and he has gained weight.

This case is very interesting and shows the typical symptoms of an infection involving the symphysis. Tenderness and pain in the region of the symphysis and pain on motion of the legs are the outstanding signs and symptoms. We believe that the infection must have resulted from the original operation. It is more likely that the injury to the symphysis was caused either directly at the time of operation or by placing the suprapubic drainage tube too near the pubis than that it was caused by undue retraction on the recti muscles, as suggested by Beer. It could, we believe, have been avoided by a slightly higher incision and by bringing the suprapubic tube out farther from the pubis. The absence of a definite abscess in the space of Retzius made us think that the symphysis was primarily infected and that the osteochondritis did not develop secondarily to a prevesical abscess, although we cannot definitely prove this contention. The marked chronicity of the condition and lack of signs of active infection were suggestive of tuberculosis but this diagnosis has been ruled out by the culture, the biopsy, and the subsequent course of the disease. The lack of X ray evidence of the condition was of course due to the fact that the infection involved only the cartilage of the joint. Although Beer states that this rather unusual complication of prostatectomy subsides without operation, this case continued for 4 months, finally ruptured into the bladder and was cured only by operation.

The second case (J B Q) had a suprapubic cystotomy on December 20 1927 and a suprapubic enucleation of the benign prostate on January 6 1928. Following the second operation he began to run a septic temperature and to show signs of general sepsis. The usual laboratory tests were done and the patient was seen by various consultants but they were unable to determine the location of the sepsis. In 3 weeks the suprapubic incision had healed but the patient continued to go down hill and to run a septic temperature without definite localizing signs. About 7 weeks after the second operation tenderness was noted in the region of the pubis and the suprapubic wound broke open and drained pus. Three weeks after that an X ray of the pelvis showed marked osteomyelitis of the symphysis pubis. Three months after the first operation the patient died.

At autopsy there was found an abscess in the pectus of Retzius which had eroded the pubic bone and completely destroyed the cartilage of the symphysis pubis. In addition to this however there was a bacterial endocarditis a low grade peritonitis infarcts of the spleen abscesses of both kidneys thrombosis of the pelvis and left renal veins and streptothricosis of the lung. Cultures from the abscess the heart and peritoneal cavity 4 hours after death grew bacillus coli.

In this case although the abscess in the prevesical space associated with the osteochondritis may have been the primary source of infection, it seems much more logical to assume that the osteochondritis was secondary to the general septicæmia.

The third case (M C H 288074) a young Canadian of 23 years entered the hospital on January 31 1928. He complained of pain in the region of the pubis of 7 months duration. In his work he had been carrying heavy boxes supporting them partly on his lower abdomen. The pain had been persistent as a dull ache often radiating down the left leg and sometimes also down the right. Working always made the pain worse so that recently he had had to stop work altogether. Associated with this he had marked frequency every half hour by day but no nocturia. He sometimes had marked urgency making the pain worse at which times he would be somewhat relieved by urination. Six months previous he had noticed a small lump in the left inguinal region which had since disappeared. Aside from these symptoms his history was unimportant.

Physical examination was essentially negative except for some tenderness just behind the pubis. The prostate was large soft and very tender but secretion obtained from it did not show pus. A complete urological examination including pyelograms was negative. The X ray of the pubic bone showed some irregularity in the pubic symphysis and also some asymmetry and disalignment of the symphysis with the sacrum. It was felt by the radiologist that the irregularity was probably only an anatomical variation and that the asymmetry was due to the position of the patient. The patient was observed in the hospital for 2 weeks. During this time his temperature on occasions varied between 97.5 and 99.5 degrees. His white blood count was normal. His symptoms all disappeared and he was discharged without any diagnosis having been made.

Ten months later he returned to the hospital and reported that he had been well for 9 months. One month previous all his old symptoms had returned. He had pain over the pubis and in the left inguinal region. In addition he had frequency and marked dysuria. Examination showed marked tenderness and spasm above the pubis and many large tender glands in the left

inguinal and femoral region. The prostate was large and soft and above it there was an indefinite soft tender mass. The urine was negative. On entry the temperature was normal but it soon began to rise. Four days later it reached 102 degrees. At this time the white blood count was 21 000 and a very definite tender mass could be palpated bimanually in the region of the bladder. An X ray (Fig 2) plate showed the same condition as in the one taken 10 months before except that the irregularity of the articular surface of the pubis was more marked and the ascending ramus of the left pubis showed three areas of decreased density associated with some increase in density of the descending ramus.

Operation was performed on the following day. A low mid line incision was carried down between the recti muscles opening into a large abscess in the prevesical space. A culture of pus from the abscess grew staphylococcus aureus. The abscess cavity extended around the front and sides of the bladder which was not opened and beneath the pubis. Cigarette drains were inserted. The patient made an uneventful recovery. After operation the prostate did not feel abnormal but the vesicles were large and tender and the secretion obtained on massage showed twenty white blood cells. He was discharged 5 weeks after operation with a small draining suprapubic sinus.

Four months after operation the patient reports that this sinus has never completely healed and that it drains a little pus from time to time. He has however had no pain or urinary symptoms. He has gained weight feels well and is working regularly.

Thus we consider a very interesting case and as we know of no other report of primary non tuberculous osteochondritis of the symphysis pubis we hesitate to discuss its etiology. The infection of the pubic bone may of course have come from the prostate and vesicles but the fact that no pus was obtained in the prostatic secretion when the patient was first seen and the fact that cultures from the prevesical abscess grew staphylococcus make us think that this infection began primarily in the pubic bone. The urinary symptoms were we believe due only to the presence of a septic process outside the bladder. The marked chronicity of the condition and the small amount of change in the X ray plate made the diagnosis difficult. We feel however upon looking back in the light of our present knowledge that we should have been able to make the diagnosis when the patient was first seen and that operation and drainage at that time should have been carried out. Like all forms of osteomyelitis the treatment has not been very satisfactory and a draining sinus has persisted. This might perhaps have been avoided if the bone had been curetted at the time of operation.

The fourth case (M C H 207851) came to the hospital complaining of a urinary stricture. Thirteen years previous he had had an external urethrotomy for stricture. Eight years ago he had had a repair of bilateral inguinal hernia in another hospital. At the time the right incision became septic and drained pus for 5 years healing only 3 years ago. Seven months ago a swelling developed at the right of the

old sinus. This broke down and began to drain pus and urine which it continued to do until entry. Nine weeks ago a suprapubic cystotomy with curettage of the sinus was performed also in another hospital. He left this hospital 1 week ago.

The important findings on physical examination from the point of view of this report were as follows: an open suprapubic wound draining pus, marked inflammation of the skin, tenderness over the pubis and a sinus in the right groin in the region of the old hernia scar. This sinus extended downward and backward toward the prostate. A small amount of pus and urine drained from it continually, and upon urination about one third of the urine passed through the sinus. The prostate was not abnormal and a No. 28 sound could easily be passed into the bladder. Cystoscopic examination showed that the bladder was normal and that the sinus entered into the prostatic urethra.

An X ray (Fig. 3) picture revealed apparent fusion of the symphysis pubis and considerable bone reaction around the symphysis without bone destruction. The changes were characteristic of an infectious process beginning in the symphysis pubis. Although this patient had been carefully studied and treated for this urinary fistula during the previous 2 months by one of the leading surgeons of the country the presence of the associated infection of the symphysis pubis had not been recognized. Several attempts were made to drain the bladder with a urethral catheter but the catheter was not tolerated. Finally the bladder was drained through an external urethrotomy incision and the sinus was curetted and partially excised. At this time rough bare bone could be felt on the posterior aspect of the pubis.

The infection of the symphysis pubis in this case may have resulted originally from a prostatic abscess or it may have resulted from infection at the time of the hernia operation. The latter explanation seems to be the more logical as it explains why a sinus persisted at the site of the hernia scar for 5 years following operation. The urinary fistula it seems might have developed as a result of a prevesical abscess coming from the osteochondritis of the pubis and rupturing into the urethra as it ruptured into the bladder in the first case. The fusion of symphysis pubis explains the lack of pain on motion which is usually an outstanding symptom. The marked chronicity suggests tuberculosis but we have been unable either definitely to prove or disprove this suggestion in this case. The X ray findings are not however suggestive of tuberculosis. At the time of discharge 3 weeks after operation the patient was voiding normally and all wounds had healed except a sinus in the right groin which was draining a small amount of pus. Since discharge the patient has unfortunately been lost track of so that we do not know his present condition. It seems unlikely however that the condition can be cured without completely eradicating the infection in the pubic bone.

#### SUMMARY AND CONCLUSION

As we have seen four cases of osteochondritis of the symphysis pubis in a year, and as Beer reports



Fig. 3. Roentgenogram of the fourth case showing marked proliferation of bone completely obliterating the pubic symphysis. This is a characteristic picture of an old infectious process in the bone.

seeing a case or more a year for 12 years we believe that the condition is much more common than one would be led to believe from a review of the literature. The frequent lack of definite X ray findings, marked chronicity of the condition and the fact that many cases get well without operation may result in the diagnosis being missed. However if the possibility of this condition is considered when the case is being examined this will probably not occur. The most common etiology is infection as a result of suprapubic cystotomy.

We have reported 4 cases. One case followed directly from a simple suprapubic prostatectomy, a second one came either from this same cause or as a result of a general septic process, a third case was apparently primary in nature and a fourth case probably followed an operation for inguinal hernia.

Although Beer found that his cases (all of which followed suprapubic cystotomy) got well without operation, our cases have all persisted for a long time and were relieved only by operation. In 3 of our cases the operations were moderately successful. The fourth case died of septicemia.

The most constant symptom was pain in the region of the pubis radiating down the legs and made worse by motion. One case showed marked urinary symptoms. Definite tenderness is present over the pubis in every case, other signs of a local inflammatory process in the region of the symphysis may or may not be present. As the cartilage seems to be first involved the X ray findings may not be definite. They are particularly hard to interpret as the symphysis pubis shows wide anatomical variations in the normal case.

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## FRACTURES OF THE CARPUS

A STUDY OF TWENTY FIVE UNSELECTED CASES<sup>1</sup>

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THE persistent pain and limitation of function following carpal damage is distressing to the patient and annoying to the surgeon. The discomfort is not alone associated with displaced fractures and dislocations but even with fissured fractures. To ascertain the reasons for these discomforts, a study of 25 consecutive cases of carpal injury treated at the New York Post-Graduate Hospital was undertaken. To begin with a superficial review of the anatomy is in order.

## ANATOMY

Each carpal bone consists of cancellous tissue enclosed in a layer of compact bone (Spitzka). The articular surfaces are smooth and covered with cartilage and synovial membrane; the other surfaces are rough for the attachment of ligaments and muscles. "The blood supply of the various bones is quite scant" (Speed).

The scaphoid, lunate and sometimes the triquetrum articulate with the lower end of the radius to form the wrist joint. The wrist joint articulation is truly condyloid and allows of all the movements of such a joint except rotation which motion is taken care of by supination and pronation of the forearm. Circumduction at the wrist joint is limited by the styloids of the radius and ulna.

The scaphoid lies between the lower end of the radius and the os magnum, acting as a buffer between the latter two bones. The os magnum fits like a wedge into the hollow of the scaphoid which, in turn, fits into the articular surface of the radius. This is particularly noted when the hand is in radial flexion. The tubercle of the scaphoid is extra-articular. The dorsal ledge of the lower articular surface of the radius hangs lower than does the palmar. When the hand is in complete dorsiflexion (hyperextension) the lower end of the radius impinges upon the os magnum while

the semilunar lies immediately beneath the flexor tendons. The joint is crossed by tendons on all sides. Occasionally a few fibers of the abductor pollicis muscle are attached to the tubercle of the scaphoid. Some of the other carpal—pisiform and trapezium—also have muscle attachments but from the standpoint of this discussion are of no great interest.

## MECHANISM OF INJURIES

When the hand is in dorsal and radial flexion which is the position assumed in falls upon the outstretched hand, the scaphoid is in direct contact with the radius and lies between that bone and the os magnum as heretofore stated so that a violence starting in the hand is carried through the os magnum to the scaphoid and thence to the radius. If the radius does not give (Colles or kindred fracture) the scaphoid cannot escape and, receiving the full force of the violence with the wedge-shaped os magnum jammed sharply against it, breaks. If the force continues, the anterior ligament gives with a resulting dislocation of the semilunar.

If the hand is in dorsal and ulnar flexion the violence is transmitted through the semilunar against the anterior ligament which tears allowing the semilunar to escape through the rent in the capsule and a dislocation of the semilunar occurs. This last type of injury is not common without a concomitant fracture or dislocation of one of the other carpals or fracture of the radius. Destot states that isolated displacement of the semilunar without luxation or fracture of the scaphoid is never seen. The most common cause for carpal damage in our series was indirect violence usually a fall from a height. When direct violence was the causative agent (1 case) a crushing injury of the soft structures was the result and associated therewith was a wound of

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Fig. 1. Air injected wrist joint. Cadaveric specimen showing fracture of scaphoid. Triangular cartilage (Courtesy of Dr. W. W. Lasher).

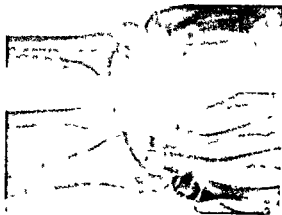


Fig. 2. Complete backward dislocation distal row of carpus. Fracture of scaphoid and radial styloid.

the skin. In 3 of our cases the injuries were due to the fact that the patients fell backward and landed on their outstretched hands. Two were caused by the kicking back of an automobile crank handle. In all of our cases severe trauma produced the injury.

#### PATHOLOGY

According to Scudder 'osseous union between fragments is the exception and fibrous union the rule'. This does not include fracture of the tubercle of the scaphoid. Speed states that following carpal fracture a condition simulating Kummels disease of the vertebra exists: the traumatized bone dies, is absorbed, a cavity forms and the residue acts as a foreign body in the joint. In our opinion, in addition to the foregoing, much of the disability following carpal fracture is due to damage of the surrounding soft structures. The cartilage, as cartilage elsewhere, has a tendency to heal unevenly and acts as a joint irritant. Neither the synovial membrane nor the tendons crossing the bones escape injury. In addition to the bony damage, we are dealing with a chondritis, arthritis, and synovitis. When the tissues are not placed at rest—so as to allow healing—secondary arthritic changes take place. The result is often a persistently painful wrist with diminished strength and limited motion. Destot truthfully states 'a mobile painful wrist is not as good as a good ankylosis'. We essentially agree with Scudder and Speed. In our series, however, we find some exceptions. We do have cases which have apparently healed by osseous union, with slight or no breaking down of the cancellous bone structure.

#### INCIDENCE

According to Speed, fractures and dislocations of the carpal bones occur about 1 in 8 to 10 times as compared to fractures of the wrist region, that is, Colles and kindred fractures.

Hirsch in 1914 stated that there were 1 or 2 scaphoid fractures to every 10 Colles or lower radial fractures (Speed).

Immelmann in 1907 studied 4,000 skiagrams of fractures to find 20 of the scaphoid (Speed).

Todd in 3,000 ambulatory fractures found 9 of the scaphoid (Speed).

Schoch in 150 fractures of the scaphoid, found only 60 of that bone alone (Speed).

Peters saw 32 cases of fractured carpal bones in one year (Speed), as follows:

Fracture of the scaphoid	18
Fracture of the scaphoid and semilunar	1
Fracture of the semilunar	8
Fracture of the semilunar and cuneiform	1
Fracture of the cuneiform	1
Fracture of the os magnum	1
Fracture of the os magnum and cuneiform	1
Fracture of the pisiform	1

Marshall collected 81 cases of carpal bone fractures from the records of the Massachusetts General Hospital. They were:

Simple fracture of the scaphoid	64
Simple fracture of the trapezium	2
Simple fracture of the cuneiform	1
Simple fracture of the semilunar	1
Fracture of the scaphoid plus fracture of the styloid process of the radius	3
Fracture of the scaphoid plus dislocation of the semilunar	5
Fracture of the scaphoid, unciform, styloid process of the ulna and dislocation of the lunate	1



- Fracture of the trapezium plus fracture of the base of the first metacarpal  
 Fracture of the scaphoid plus fracture of the styloid process of the ulna  
 Fracture of the navicular plus fracture of the base of the first metacarpal

(Speed)

Bizzaro, in 123 cases of carpal injury, found the scaphoid alone was fractured in 68 and the scaphoid fractured in association with other bone lesions in 38 or a total of 106 scaphoid fractures.

Robinson reported a case of backward dislocation of semilunar

Carter studied 250 roentgenograms of wrist joint injuries and found 4 per cent were injuries to the carpus, equally divided between scaphoid and semilunar. He had one dislocation of the semilunar associated with fracture of the radius.

Destot in 1921 collected the following cases

Fracture of the scaphoid	150
Fracture of the semilunar	80
Fracture of the os magnum	4
Fracture of the cuneiform	6
Fracture of the trapezium	4

In our list of cases we found the following

Fracture of the scaphoid with fracture of radial styloid	1
Fracture of the scaphoid	13
Dislocation of the semilunar	5
Dislocation of the semilunar associated with the fracture of the radius	3
Dislocation of all of the carpals except the semilunar	1
Dislocation of the proximal carpals on the distal	1
Dislocation of the carpus with fracture of the radius	2

The apparent discrepancy is due to the fact that in one of our cases both wrists were involved. It is evident that the scaphoid is the carpal bone most frequently damaged. When the anatomy of the wrist is considered, the reason for the more common scaphoid fracture is obvious. All of our cases were in males, the youngest patient was 17 years old while the oldest was 53 years of age. In 19 cases the right hand was involved and the left hand in 17. Again an apparent discrepancy for the reasons above stated.

#### SIGNS AND SYMPTOMS

Signs and symptoms common to all carpal injuries are swelling, limitation of motion, pain aggravated by motion, and acute tenderness over the site of the lesion.

In fractures of the scaphoid the acute tenderness is in the tabatiere, both active and passive motion is painful with the pain greatly increased when the hand is in dorsal or radial flexion. In direct pain is elicited by jamming the thumb

against the carpus. Radiographic examination of both wrists should always be made since the existence of a bipartite scaphoid must be remembered.

In dislocation of the semilunar disability is almost complete. The wrist and fingers are greatly limited in motion, the fingers are flexed, the dorsal flexion of the wrist is very painful and limited. Extension of the fingers is accompanied by pain. An undue prominence is noted on the anterior surface of the wrist. Radiographic examinations should always be in at least two axes.

Moorhead's axiom, that every crippling or disabling injury at any joint except the shoulder joint should be considered a fracture until proved otherwise, is most appropriate at this joint.

#### TREATMENT OF SCAPHOID FRACTURE

Where there is no displacement of the fragments the wrist and hand are immobilized with the wrist in dorsal flexion and the fingers flexed. The thumb is also immobilized and held in abduction and complete extension. A cock up splint of either metal or plaster of Paris extending from just below the elbow to just above the web of the fingers with an extension for the thumb is applied. This position is maintained for from 6 weeks to 2 months. Where there is displacement of the fragments designated by us as Type 1 in contradistinction to the non displaced or Type cases steady traction on the fingers with the hand in palmar flexion is employed so as to widen the space between the carpus and the radius. At the same time pressure is made upon the displaced fragment in an effort to force it into its normal position. Failure to secure proper reduction should be followed by immediate removal of the offending bone or the displaced part thereof else it will act as a foreign body and an irritant to the joint with a resultant limitation of motion and pain. The German surgeons have been inclined to remove the entire scaphoid while we favor the removal of only the displaced fragment. From the literature one is inclined to believe that the end results are about the same. However in cases in which a fracture has existed for some time with out being recognized and consequently no attempt at reduction has been made, it is necessary to obtain good function of the wrist to remove the entire bone. After reduction is obtained immobilization for 6 weeks is advisable. After the first 3 or 4 days massage and baking of the wrist should be carried on daily without removing the splint and without moving the joint. After 6 weeks the splint is removed and a wristlet is worn for a fortnight. With the removal of the splint

massage, baking, and active motion are employed. The period of disability is from 2 to 4 months.

Codman and Chase believe that non union is a result of failure to immobilize the wrist properly. However, a certain number of cases—in spite of proper immobilization—do fail to unite and give a weak and painful wrist. This type should be operated upon within 3 months, otherwise the arthritic changes become quite marked. Decision to operate should not rest with the X ray findings alone, since X ray examination may show an apparent non union and yet the condition may not require operative interference. One should be guided by the physical examination and history.

To expose the scaphoid we have found the best approach to be by an incision on the dorsum of the wrist over that summit of the radius which exists between the grooves through which the extensor longus pollicis and the extensor indicis tendons pass. With the hand in palmar flexion the wrist resting upon a sandbag, an incision is made over the point mentioned, to extend 1 inch above and an equal distance below the articular surface of the radius. When the joint is opened the scaphoid comes into view, since the scaphoid is the first bone to be seen below the articular surface of the radius. This method of approach eliminates the danger of mistaking another of the carpal bones for the scaphoid, a not altogether uncommon occurrence. Through the usual method of approach, that is through the tabatiere if one is unfortunate enough to tilt the hand radially, the trapezium comes into close contact with the radial styloid and might be unwittingly removed. After removal of the scaphoid or a fragment thereof, active motion is immediately begun.

#### TREATMENT FOR DISLOCATION OF THE SEMILUNAR

An attempt at closed reduction should always be made. The steps are steady traction on the hand and hyperextension (dorsal flexion) of the wrist. These two steps should be steady and sustained. Then, the wrist is brought into palmar flexion while pressure over the displaced bone is exerted. If the gap between the lower radial articulation and the carpus is sufficiently widened the offending bone will slip back into place with this manipulation. The wrist is immobilized for 1 week, and then massage, baking and active motion are instituted.

After two unsuccessful attempts at closed reduction open operation is indicated. The method of approach is from the anterior surface of the

wrist. Incision is made over the summit of swelling, tendons that are encountered are retracted, and the semilunar is exposed.

If the bone can be replaced without much trauma to the joint, it should be done. We have been successful in this closed replacement method in cases seen within 24 hours after the injury.

Where such replacement necessitates greater manipulation and increased traumatism to the joint then the semilunar is removed. Functional results are good. Early massage and early active motion hasten the restoration of function.

Farr was able to reduce a dislocation of the carpal semilunar on the day of the accident, with great ease and obtained an excellent result. He states that late reduction or late excision may give good, but not perfect, function. Ten per cent of stiffness and weakness of the wrist usually occurs in late cases.

No attempt at either closed or open reduction of carpal fractures or dislocations should be made without the use of an anæsthetic. While operations under direct infiltration and block anæsthesia have been successfully performed, the writer feels that the best results are obtained with the patient under general anæsthesia.

#### END RESULTS

It is the opinion of the writer that 100 per cent perfect end results following fractures at any joint rarely exist. This is particularly true in carpal fractures or dislocations. In judging our end results, we follow the method as described by Moorhead.

On the basis of 100 per cent for a perfect result, he allows 60 per cent for function, 20 per cent for contour, and 20 per cent for union. Our study of 25 cases made after a lapse of at least one year from the time of injury gave the following rating: 49 per cent for function, 12 per cent for union, and 15 per cent for contour, or a total of 76 per cent. It must be remembered that this end result was not alone for fracture of the scaphoid and dislocations of the semilunar, but also included injuries to the other carpals, some of which were extremely severe and of the crushing type of fracture, some associated with dislocation. Among the fractures of the scaphoid, we had 7 perfect results, while in 5 there was definite interference with joint function. Of these 5, 2 were the result of open operation. Of the 8 dislocations of the semilunar but 1 gave a perfect result.

Deductions were made for painful joints, limitation of motion, scarring, deformity, and apparent non union of the fragments. In the painful joints, definite arthritic changes were noted.

associated with crepitus on motion of the wrist and fingers

#### CONCLUSIONS

1 The scaphoid is more often damaged than all the other carpals

2 Dislocation of the semilunar is frequently associated with a fracture of either the scaphoid or articular surface of the radius

3 Osseous union in carpal fractures is the exception, fibrous union the rule

4 Much of the disability following carpal injuries is due to intra articular soft structure damage

5 Early attempts at closed reduction of scaphoid fractures or semilunar dislocations should be made

6 Failure to obtain proper reduction by closed manipulation should be followed by immediate open operation

7 Cases of carpal fracture treated unsuccessfully by immobilization should be operated on within 3 months lest irreparable subsequent arthritic changes take place

8 Carpal fractures, due to the type of bone, do not heal kindly, except fractures of the tubercle of the scaphoid which is definitely osseous

9 No fracture or dislocation of the carpus ever exists without an associated chondritis, synovitis, and tenosynovitis

10 Both wrists should always be examined with the X ray as an aid to diagnosis but the physical findings should be the guide in judging the end result

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END RESULTS AFTER BILLROTH I RESECTION OF THE STOMACH  
AS MODIFIED BY DR J SCHOEMAKER

DR A A BUYTENDORP, MARACAIBO VENEZUELA

TO give a clear idea of the anatomical alterations in stomachs which have been resected according to the method to be discussed, I will give a description of Dr Schoemaker's technique as described in the *British Journal of Surgery* in 1922<sup>1</sup>

"The abdomen is opened by a median incision from the sternum to the umbilicus, and the wound is held open by a self retaining retractor. The duodenum is lifted up and the attachment of the omentum clamped and cut in sections. Two small clamps are placed on the first part of the duodenum, which is then divided by the knife. The distal end is covered with gauze whilst the proximal end is protected by a little shield, which fits on to the clamp. The remaining portion of the small omentum is clamped and cut in sections, the coronary artery being divided in the last. A large pair of special clamps (Fig 1) constructed in two portions is then applied to the body of the stomach the blades of these clamps, which are about five inches long, are curved in about the same shape as the normal lesser curvature of the stomach. When in position the blades extend from a point on the lesser curvature of the stomach opposite to the coronary artery at the junction of the middle and upper thirds of the stomach, to a point about an inch and a half from the greater curvature of the stomach and two inches from the pylorus. The portion of the stomach between the right end of the stomach clamp and the greater curvature is seized by a pair of small forceps like those for colectomy. The stomach is then cut through by a knife applied close to the clamps, large and small. This frees the pylorus and lesser curvature of the stomach, that are removed. The large stomach clamp consists of two portions. After cutting away the pylorus, the distal portion of the clamp is unscrewed and slipped out thus leaving a compressed edge of stomach wall rather more than one eighth of an inch in extent projecting from the remaining portion of the clamp (Fig 2). This projecting edge is sewn over by a continuous catgut stitch, and the remaining portion of the clamp is then taken away and a second continuous Lembert stitch completes the closure of this portion of the gastric wound. The stomach has now been reduced to a more or less tubular structure,

the end of which is closed by one small colon clamp. This is brought into apposition with the duodenum, and after two more clamps have been applied proximal to the gastric and distal to the duodenal forceps, an end to end junction is effected (Fig 3). The deep surfaces of the viscera are joined by interrupted silk sutures. The terminal clamps are taken off and the whole thickness of the stomach and gut united by a series of interrupted stitches, whilst the anterior layer is completed after the remaining clamps have been removed.

The Billroth I resection is done in all cases of gastric ulcer and also in the cases of duodenal ulcer provided the duodenum can be made movable so that an end to end anastomosis can be made. Some surgeons fear that it may not be possible to make the suture at the point where the new lesser curvature and anastomosis meet sufficiently tight to prevent leakage. Dr Schoemaker has never experienced this difficulty as long as he has been practicing his method. In this method a great part of the lesser curvature together with the ulcer is always removed, so that the so called ulcer bearing area is excised.

Eighteen patients suffering from ulcer in the stomach and duodenum were examined before and after operation by means of fractional test meals. Several sorts of test meals can be given. In Germany several investigators give an alcohol test meal with the addition of some caffeine and a few drops of methylene blue. As this irritates the stomach too much we prefer the test meal advised by McLean. Finely ground oatmeal is boiled in water and strained through muslin, so that the liquid is clear, is very easily aspirated, and does not tend to block the tube. Instead of the methylene blue, we add tincture of iodine to the different specimens to determine the emptying time of the stomach. As long as there is starch in the specimens, they will show a blue color. In our series we have never had any ill effects from the introduction of the tube. The tube used is the duodenal tube as devised by Rehffuss.

Acid and total acid determinations are made with the ordinary methods, the total chlorides with the Van Slyke method. The number of cubic centimeters of alkali used for the first titration when multiplied by 0.0365 gives the

<sup>1</sup>Brit J Surg 1922 x 124

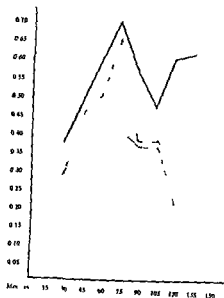


Fig 1 High acidity in resected stomach

"free acid" percentage, the number of cubic centimeters used after adding phenolphthalein multiplied by the same factor gives the "combined acid"

The tube is kept in for 150 to 180 minutes. The discomfort of the patients is not great, therefore we cannot speak of a psychic inhibition of the digestive process. The curves thus obtained are, truly speaking, acidity curves and not secretion curves as Katsch and Kalk showed, although some idea of the secretory power of the stomach is obtained.

The normal stomach presents a curve showing a rise in hydrochloric content as the process of digestion begins followed by a fall, as the stomach empties, whereas the total chlorides give a more slowly ascending curve, which very often makes a sharp turn upward at the point at which the acid curves begin to descend. Heidenhain and Pawlow explain this by the fact that neutralization takes place through the alkaline content of the stomach. The most important of these are the mucus of the stomach, the pyloric secretion which is alkaline, and the regurgitation of the intestinal contents (gall and pancreatic fluid).

The importance of the pyloric secretion is not great, according to Pfandl it amounts to one tenth normal sodium hydroxide per 100 cubic centimeters. As to regurgitation of the duodenal contents, a direct relation has not been established between the descending acid curves and the ascending chloride curves. Boldyreff found

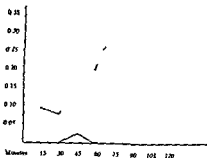


Fig 2 Patient had a gastro-enterostomy and 8 years later a resection

that regurgitation of the intestinal fluid takes place under certain circumstances, for instance, in the presence of a great amount of acid or oil in the stomach. Roseman believes that it is more physiological to accept a change in the formation of hydrochloric acid during digestion.

In all the stomachs resected we have always found a subacidity and sometimes a total absence of free chlorides. The total chlorides have been diminished slightly, although we have not always found large amounts of gall or trypsin in the stomach specimens. This contradicts the alkalinizing action of the intestinal contents. Why gall and intestinal contents are found in all specimens will be shown later on.

That even a resected stomach if too much of the antrum is left, may show high acidity curves is demonstrated in Figure 1. At the second operation in this case no ulcer was found but only a slight stenosis. Stenosis alone, however, does not always cause hyperacidity, as is shown in the curve in Figure 2. This patient first had a gastro-enterostomy, 8 years after that a resection. At the examination of the stomach contents and at X-ray examination after the resection there was marked retention although the curve showed strong hypacidity.

The two main factors causing the diminished acid content of the stomach are the removal of the pyloric mechanism and the removal of the ulcer bearing area. The pylorus as a regulator of the output disappears. A sphincter may be formed but an autonomic co-ordinating sphincter is never secured. The manner in which a stomach operated upon by the Billroth I method empties is mainly hydrodynamic in character especially in the upright position.

As we already have stated most of the resected stomachs show a slight retention. This might be due shortly after the operation to a postoperative weakening of the muscles, although in some

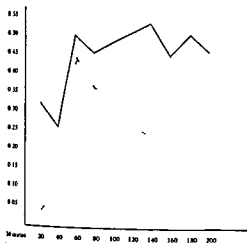


Fig 3 Differences in acid content before operation

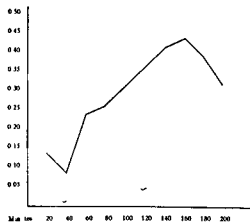


Fig 4 Difference in acid content after operation

stomachs observed a long time after the operation a slight retention has been found. Also in X-ray examinations we find retention after the bismuth meal, it is not great but very often it is evident.

Most authors describe a very rapid emptying time in stomachs resected and sometimes patients complain of it. This difficulty is very rarely seen in the patients operated upon by Dr. Schoemaker's method. It is also true that complaints of retention are few when the Schoemaker method is used. Excessive retention is caused by two things: first, when the new formed lesser curvature shrinks, the greater curvature becomes relatively too long, and second when the greater curvature is left too long at operation. As to whether excessive retention may be due to muscular hypotonus I have been unable to decide. One point should be kept in mind and that is that very often in this method of resection we remove the vagus nerve. It courses as a fine white thread through the uppermost part of the lesser curvature. When the lesser curvature is resected high up the nerve fibers of the remaining part of the stomach are resected. The influence of the vagus on the resected stomach is not yet very clear, but it may be a factor in the production of the relatively longer emptying time in stomachs resected after the technique described. It would be very beneficial to compare the stomachs with and without vagus resections, especially as some surgeons have been obliged to operate again on stomachs which have been resected as the patients complained of the too rapid emptying of the stomach.

Regarding the behavior of the new gastric outlet, in most of the cases reported we find that

the new formed pylorus does not work but is always open. Arisz found roentgenologically, by serial exposures of the exit, that it formed a narrow canal, the diameter of which varied between  $\frac{1}{2}$  to 3 millimeters. At operation we can easily put at least one finger through the newly formed pyloric canal.

Two things are possible: either a stenosis or the formation of a localized muscular spasm acting in part as a new pylorus. Stenosis may be eliminated as a stenosis would not show changes in width during X-ray exposures. Besides, in one patient suffering from a recurrent ulcer after a Billroth I resection, the radiologist saw an opening the same as that already described, whereas at operation I could very easily pass a finger through the pyloric ring. Arisz described a similar case in which the patient afterward was operated upon for another reason and in which a finger could very easily be passed through the opening. Forsell and Hellmer attributed this change of tonus to a change in the tonus of the muscularis mucosae, which because of the nature of the operation is re-enforced at this spot. Goetze describes the mechanism of the new gastric outlet a little differently. He emphasizes the behavior of the duodenal bulb. He found that it filled more readily than in the normal stomach and sometimes became double the normal size. But in most of our cases the bulb is removed.

Very apparently the new outlet does not function as does the pyloric sphincter so that the food flows directly into the duodenum. Although in these stomachs we find that some kind of sphincter is formed, yet there is no comparison between it and the finely regulated mechanism of the normal stomach.

As the food passes more quickly into the duodenum, we find a higher acid content of the duodenal contents, with the result that there is a diminished pepsin action, but as the greatest part of the peptic digestion takes place in the intestine, we must not lay too much stress on this fault in intragastric digestion. Of more importance might be the diminished bactericidal action of the normal acid gastric juice we haven't seen, however, a great difference in the liability to gastro enteritis in stomachs resected by the Schoemaker method. In most of the specimens taken from resected stomachs we have found an increased amount of mucus, that is, in stomachs examined a rather short time after operation. In one stomach operated upon 4 years before, I could not detect an increase in mucus. The additional mucus, however, does more good than harm, as it protects the stomach wall against too sharp and rough food. However, in stomachs in which the segment of duodenum left is longer than usual the duodenal bulb is filled by the rapidly inflowing gastric contents. The sphincter of the duodenal bulb although much weaker than the pyloric sphincter presses the food backward into the stomach, thus regulating to some extent the gastric outflow—a mechanism of more importance in the too rapidly emptying stomach.

In stomachs resected after the Schoemaker technique the emptying time is not so rapid as that mentioned by other authors. This has been proved by our fractional test meals and has been described by Ansz roentgenologically. The average emptying time found in our cases is 35 to 45 minutes. Ansz found the time 30 minutes, but when he gave a test meal of barium with potatoes

and meat the emptying time became 3 hours, so that we see that the emptying time is dependent upon the sort of food taken.

The secretion time in our series is also much longer than was described by Goetze. Whereas he found an average time of 90 minutes, in our cases it varied between 110 to 160 minutes. As already mentioned, we found in almost all our resected stomachs slight retention. Specimens of material retained never showed the presence of free acid and in 14 of 18 stomachs no acid at all could be found. As to the secretion, we found in all the cases an hypacidity and in one nearly an acidity, whereas the total chlorides did not change much. In one stomach examined 4 years after operation the same hypacidity existed as at operation. The hypacidity therefore is not a temporary one, as is sometimes the case after gastro-enterostomy. In a series of cases in which gastro-enterostomy had been done Berberich found a subacidity directly after operation but after 3 years the acid content became normal. This was not mentioned in the series of resected cases. Figures 3 and 4 will give a good idea of the difference in the acid content before and after resection.

#### SUMMARY

In all cases properly resected, a subacidity was found.

There were no complaints of a too rapid emptying time or of regurgitation.

If the ulcer and the ulcer bearing area are properly removed recurrence is very seldom found.

A study is still being carried on in this clinic as to the incidence of recurrent ulcers.

FRACTURES OF THE PELVIS<sup>1</sup>

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**I**N this industrial and mechanical age, fractures are not unusual occurrences and the incidence of certain fractures has increased materially. Fractures of the pelvis are no longer infrequent, and it is the purpose of this clinic to review a series of 35 consecutive cases of pelvic fractures admitted to the Beekman Street Hospital, New York, from January 1, 1925, to October 1, 1928. This group includes not only fractures of the os innominatum but traumatic separations of the symphysis pubis, and the sacro iliac synchondroses, as these articulations are practically synostoses in the adult.

The ages of the patients varied between 6 and 68 years, the average being about 34 years. As would be expected, over one half of the patients were between the third and fourth decade, the time of life in which the capacity for physical vigor is high. It is rather interesting to note that there were only three females in this group, but this is easily understandable when the industrial hazard of most feminine occupations is considered.

It is quite natural that the majority of these injuries should occur in those engaged in trades operating at varying heights above the ground. Table I summarizes these occupations, and Table II demonstrates that the more inactive outdoor occupations are associated with less traumatic risk. Table III however, graphically indicates the traffic hazard in a congested metropolitan area, for although more than one quarter were engaged in sedentary or indoor occupations, 14 per cent suffered their injuries while going to and from work.

TABLE I—ACTIVE LABOR, MOSTLY OUTDOORS, WITH CONSIDERABLE RISK OF SEVERE TRAUMA—20 CASES, 57.1 PER CENT

	Cases
1 Laborers unqualified	6
2 Superintendent of laborers	1
3 Bricklayer	1
4 Iron worker	1
5 Truckmen	3
6 Window cleaners	2
7 Longshoremen	2
8 Carpenter	1
9 Fisherman	1
10 Seaman	1
11 Machine hand	1

Over one half of these patients were injured while working. In other words, over 50 per cent

of the cases were subject to the New York State Workmen's Compensation—their employers being responsible and liable for compensation and many of the remainder came under the heading of "negligence cases." It is quite evident that fracture of the pelvis is of serious economic importance.

The nature of the trauma producing the injury may be of three varieties: injury by falling, crushing or collision. These three types are enumerated in Tables IV, V, and VI.

The diagnosis of fracture of a pelvis rarely presents difficulty. Fifteen cases were fractures of the ilium, 24 of the pubis. Four cases disclosed fractures of the ischium, and in 1 case the fracture was at the junction of the ischium pubis and acetabulum. There were four fractures of the right acetabular cavity and two of the left. There was a separation of the pubic symphysis in four instances. Dislocation or separation of the sacro iliac joints, was present in 5 cases.

From the very nature of the mechanism causing the injury, it is quite evident that a fractured pelvis is invariably accompanied by other fractures. This occurred in over 48 per cent of the cases. As a matter of fact, the number of fractures per patient varied from one to eleven. Some of the locations of other fractures were skull, scapula, humerus, radius, ulna, ribs, lumbar vertebrae, sacrum, tibia, fibula, and astragalus.

Practically all of these patients received other injuries in addition to the fractures, and most of the complications were caused by the initial

TABLE II—OUTDOOR OCCUPATION, LESS ACTIVE, AND WITH LESS RISK OF TRAUMA—6 CASES, 17.1 PER CENT

	Cases
1 Schoolboys	3
2 Policeman	1
3 Chauffeur	1
4 Peddler	1

TABLE III—SEDENTARY OR INDOOR OCCUPATIONS—9 CASES, 25.7 PER CENT

	Cases
1 Clerks	2
2 Stenographers	2
3 Merchants	2
4 Porter	1
5 Insurance broker	1
6 Housewife	1

<sup>1</sup>From the Surgical Service of the Beekman Street Hospital, New York.



TABLE IV—INJURIES BY FALLING—15 CASES,  
42.8 PER CENT

1	Fell 3 feet landing on plank
2	Fell through hatch cover into hold of ship
3	Fell under L. train
4	Fell 10 feet
5	Fell 12 feet downstairs
6	Fell 1 story down elevator shaft
7	Fell 1 story from scaffolding
8	Fell 35 feet
9	Fell 2 stories from scaffolding
10	Fell from L. platform to street
11	Fell 60 feet from scaffolding
12	Fell 3 stories
13	Fell 3 stories from window to street
14	Fell 5 stories into skylight
15	Jumped 5 stories down airshaft

TABLE V—INJURIES BY CRUSHING—13 CASES,  
37.1 PER CENT

	Cases
1	Crushed between two trucks
2	Crushed between truck and platform
3	Crushed between floor and elevator
4	Crushed in elevator
5	Run over by automobile
6	Struck and run over by taxi
7	Run over by horse and cart
8	Run over by truck
9	Taxi overturned crushing patient
10	Thrown to ground in auto accident

TABLE VI—INJURED BY COLLISION—7 CASES,  
20 PER CENT

	Cases
1	Struck by truck
2	Struck by automobile
3	Struck by street car
4	Street car collision
5	Taxicab collision
6	Struck in groin by boom of fishing boat

trauma. The associated injuries included abrasions, contusions, lacerations, and burns of practically all areas of the body, genito-urinary injuries such as rupture of the urinary bladder in 3 cases (one with extravasation of urine), contusion of the bladder in 1 case, temporary paralysis of the bladder in 1, and a rupture of the urethra in 2 cases. Some of the other complications were punctured pleura, traumatic pneumothorax, cerebral concussion, ruptured jejunum, general peritonitis, lumbosacral sprain, compound dislocation of astragalus, hematoma of various regions, and abdominal wall infection. These complications added to the fractures already mentioned demonstrates the enormous amount of injury suffered by these patients and shows what an important rôle fracture of the pelvis plays in traumatic surgery. X-ray examination of these cases which is always essential, discloses very interesting find-

ings. Displacement and separation of fragments were present in some degree in 28 or 80 per cent of the cases, and absent in 7 or 20 per cent. No displacement was mentioned in 2, slight separation in 6, considerable separation in 2, separation of a chip in 2, complete dislocation of the sacroiliac joint in 3, subluxation of the sacroiliac joint in 2, and separation of the symphysis pubis in 5 cases.

The most important symptom of a fractured pelvis is pain. The location of the pain is given in Table VII.

TABLE VII—LOCATION OF PAIN

		Cases
1	Generalized pain in pelvis	51.3 per cent 18
2	Pubic region	1
3	Iliac region	4
4	Over symphysis pubis	1
5	Hip	1
6	Back	7
7	Croon	3
8	Thigh	3
9	Lower abdomen	17.1 per cent 6
10	Right calf	1
11	Foot	1

Tenderness is regularly present. Its location is shown in Table VIII.

TABLE VIII—TENDERNESSES

	Cases
1	Pelvis in general
2	Abdomen
3	Iliac region
4	Iliac crest region
5	Hip
6	Pubic region
7	At symphysis pubis
8	Back
9	Sacral region
10	Inguinal region
11	Thigh
12	Calf of leg
13	Foot
14	On lateral compression of pelvis
15	Tenderness of pelvis on motion of leg

Swelling was visible in a large number of cases. Subcutaneous hæmorrhage was noted as shown in Table IX.

TABLE IX—SWELLING

	Cases
1	Hæmatoma of the lumbar region
2	Hæmatoma of iliac region
3	Echymosis of buttock
4	Echymosis of sacrum
5	Echymosis of abdomen
6	Echymosis of scrotum
7	Echymosis of perineum
8	Echymosis of thigh
9	Echymosis of hip

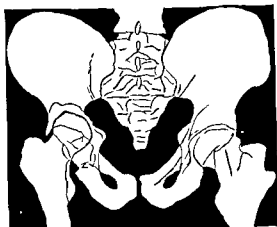


Fig 1 J N K male 49 years of age policeman thrown in automobile accident X ray examination disclosed an 8 months old fracture of right acetabulum and depression of acetabulum so that the head was driven one half way into pelvis. Now healed. He also received a laceration of the sciatic nerve and developed a traumatic sciatic neuritis. The result in this case was poor. Although there was  $1\frac{1}{2}$  inches shortening the movement of the hip joint was perfect. His poor result was due to nerve injury with atrophy of muscles weakness pain etc.

Shock was severe in 18 cases. Two cases were unconscious at the time of admission the unconsciousness, however, being caused by the associated injuries.

Six of the patients, or 17 per cent, were unable to void, 2 unable to use their legs and 1 had a temporary anaesthesia of the feet and legs.

The majority, upon arrival at the hospital, were completely disabled, 11 had practically complete disability and 22 were partially disabled.

Crepitus is rather an unusual physical sign in this type of fracture and was present in only 3 cases.

The right foot was externally rotated in a case of the fracture of the left ischium with a spreading of the left sacro iliac joint.

Voluntary limitation of motion of the extremities was mentioned in 4 cases. It was rather interesting to note that in many of these cases certain abdominal symptoms were present which were probably due to reflex spasm incident to fractures of the pelvis. Abdominal examination revealed muscle spasm in 8 cases, distention in 3, tenderness in 7 and ecchymosis of the lower abdominal wall in 1.

Bladder injury has always been thought to be quite common in this type of fracture. Haematuria was seen in 3 cases, in one of which almost pure blood was removed by catheter. Two cases

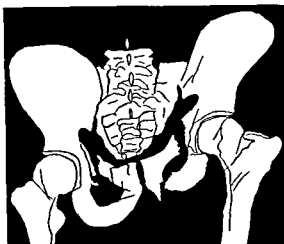


Fig 2 L S male 32 years of age X ray examination disclosed 6 fractures of the pelvis as follows: (1) at junction of horizontal ramus of left pubis and ischium with  $\frac{3}{4}$  inch separation; (2) at descending ramus of left pubis with  $1\frac{1}{2}$  inch separation; (3 and 4) fractures of the horizontal ramus of the right pubis; (5) fracture of descending ramus of right pubis; and (6) fracture at juncture of right ischium, pubis and obturator foramen with  $\frac{1}{2}$  inch separation. Upward and backward displacement of left pelvis. This man fell from the fifth story into a skylight while cleaning windows. Beside the multiple fractures of the pelvis he sustained a fractured sacrum and 2 transverse vertebral processes. He developed a haemolytic streptococcus infection of a hematoma of the sacral region which was drained several times. He died after 41 days of multiple fractures plus infection plus haemorrhage from the abscess cavity.

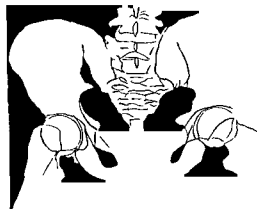


Fig 3 B D male 45 years of age X ray examination disclosed a separation of right sacro iliac joint and symphysis pubis. This laborer fell 35 feet and also received fractures of 2 transverse vertebral processes as well as a ruptured bladder and many other injuries. He died a cardiac death after 29 days in the hospital.



Fig 4. R. R. male 32 years of age. X-ray examination disclosed an oblique fracture through right ilium from sacroiliac joint to crest. Comminuted fracture of crest. Fracture of both rami of pubis. Practically no displacement. This man was crushed between two trucks. His recovery was uneventful and he left the hospital after 54 days. Two months later he complained of pain in the pelvis and inability to do hard work as yet. Nothing further has been heard from him.



Fig 5. A. B. male, 42 years of age. X-ray examination disclosed a fracture of left ischium, spreading of left sacroiliac joint. This man, an ironworker, fell two stories from a scaffolding and received in addition to the above a fracture of the base of the skull. After 10 hours he died from the fractured skull plus shock.



Fig 6. M. D. female 10 years of age. X-ray examination disclosed a fracture of both rami of left pubis. Fracture through ramus of right pubis near ischium and through ascending ramus at body and acetabulum. Also comminution of pubis. Right side good position. Left pubic foramina considerably separated. Left ilium displaced upward. This young lady was in a taxi cab which overturned giving her the above injuries plus fractures of the sacrum and of an articular vertebral process. She was walking in 7 1/2 weeks and left the hospital after 58 days. She was seen and examined a few weeks ago, practically 4 years since injury and found to be in excellent health with no symptoms or signs of any injury.

were accompanied by extravasation of urine, one to the scrotum and one to the inguinal region. Injection tests were done for evidence of bladder injury in 4 cases. In 1, air was injected and in the roentgenograms air could be seen in the bladder and also in the perineum outside of the bladder. The installation of sterile saline in 3 other cases showed that the bladder was intact.

The treatment of these cases resolves itself in the treatment of the fracture and the complications. Rest in bed is the most important part of the treatment for the fracture and in the majority it was practically the only treatment administered. All patients were put flat on their backs in bed and kept there on an average of 30 days. Patients were allowed up gradually, first being rolled, and later turned in bed, then permitted to use a wheel chair, and finally they were allowed to walk. The length of time after injury that patients were allowed to walk averaged 38 days. Callus was demonstrated by the X-ray in some cases before the patient was allowed to walk. The patients in whom displacement and comminution of the fragments were marked were kept in bed for the longest period of time. Two patients were kept on fracture boards and one on an air mattress. The pelvis was strapped in 2



Fig 7 S B male 38 years of age X ray examination disclosed 3 fractures of left ilium subluxation of sacro iliac joint Separation of symphysis pubis Fracture of left acetabulum Left ilium rocked backward This man fell from an elevated railway to the street receiving besides his fractures of the pelvis fractures of 2 ribs and a traumatic pneumothorax He was kept in the hospital 57 days 47 of which were in bed Over a year later he was at sea reported to be in good physical condition



Fig 8 M H H male 32 years of age X ray examination disclosed a long fracture of right ilium with  $\frac{1}{4}$  inch separation This man was run over by a truck while crossing the street and received in addition to the above fractures of 4 transverse vertebral processes With only 3 weeks in bed the patient left the hospital in a little over a month We were never able to trace him

instances and 2 patients were fitted with supporting elastic belts A Balkan frame with traction on the leg to pull down a posterior displacement of the ilium was used unsuccessfully in 1 case

This study certainly emphasizes the simplicity of treatment of fractures of the pelvis It should be particularly noted that no patient was operated upon that no casts were used, and that traction was employed in only one instance Even the advisability of an air mattress and fracture board is an open question The indication for their use is purely dependent upon the patient's comfort

During the past year we have been inclined to use elastic pelvic supports and we believe that the support is highly advisable especially in complete comminuted and separated fractures We feel that a polo belt may be used to great advantage

Operations were performed only when complicating injuries to soft parts required it Brief outlines of these case histories follow

CASE 1 H H male aged 43 years was injured in a street car collision He received a fracture at the junction of the left ischium pubis and acetabulum with separation of the left sacro iliac joint also rupture of the urinary bladder and prostatic urethra with extravasation of urine and a hematoma of left thigh He was operated upon after reacting somewhat from shock A tear  $1\frac{1}{2}$  inches long was found in the anterior wall of the bladder extra peritoneally with extravasation of blood and urine into the rectus muscles The bladder and the space of



Fig 9 P D male 35 years of age X ray examination disclosed a transverse fracture of body of left ilium no separation This patient was crushed in an elevator and besides the above received fractures of ribs the scapula and of a transverse vertebral process Notwithstanding having had cerebral concussion and lobar pneumonia he was getting along nicely and was still in the hospital at the time of writing 13½ months after injury

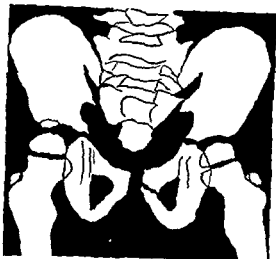


Fig 10 J C male 6 years of age. X-ray examination disclosed a fracture of right obturator foramen, no displacement. This schoolboy was run over by a horse and wagon. He also sustained a fractured humerus and other injuries. His parents removed him from the hospital after 32 days of satisfactory progress and nothing has been heard from him since.

Retzius were drained. The abdominal wound became infected and was opened for drainage. A secondary operation was done later. As the infection was not controlled a peritoneal urethrotomy, retrograde catheterization of the urethra and perineal drainage of the spine of Retzius were performed. A blood transfusion was given on the seventh day but the patient died on the fourteenth day from infection.

CASE 2. B D male aged 45 years fell 35 feet while working. He sustained a separation of right sacro iliac joint and symphysis pubis, fractures of both transverse processes of the fourth lumbar vertebra, a rupture of the bladder and an enormous hematoma of the sacral region. A suprapubic cystostomy was done on the second day, two rents in the anterior bladder wall were found, both extra peritoneal, one measuring three quarters of an inch, the other one half inch. One tear was sutured the other used for drainage. The hematoma of the back was incised and drained. The bladder and surrounding tissues became infected and additional stab wounds in the groin were necessary for adequate drainage. The patient did well until cardiac decompensation occurred. This would not yield to treatment and death occurred on the twenty ninth day after the injury.

CASE 3. R D male aged 18 years fell under an L. train receiving multiple fractures of the left humerus and a severe crushing injury of the abdomen. His condition was extremely poor. No definite abdominal diagnosis was arrived at until the next day when at operation two perforations in the jejunum with acute diffuse peritonitis were found. The patient died 3 hours after operation.

CASE 4. F S male aged 50 years was crushed between two trucks, sustaining a fracture of the right pubis with deformity, a fracture of the right tibia and fibula, rupture of urethra and contusions and abrasions of hips. He was operated upon with a provisional diagnosis of ruptured bladder. None was found so a suprapubic cystostomy was

TABLE X—OCCUPATION SINCE INJURY

	Cases
1 Same type of work as before injury	0
2 Less strenuous work	3
3 Not able to work since accident	2
4 Not working because still receiving compensation	2
5 Not working because of inability to find work	1
6 At sea apparently working	2
7 Thought to be doing hard work	1
8 Working until injured again now in another hospital for some other injury	1
9 Unknown	1

TABLE XI—LATE SYMPTOMS

1 Pain in right iliac region on sneezing or coughing or prolonged weight bearing	
2 Slight muscular weakness of left leg	
3 Slight pain in pelvis in bad weather	
4 Slight continuous pain in back	
5 Slight pain in right hip and at region of right ischial tuberosity after resting improved on motion or walking	
6 Slight pain in back after long walking or running	
7 Slight pain in right hip, worse with rest improved on walking	
8 Slight pain in region of sacro-iliac joints	
9 Increased pain on stooping improved on walking	
10 Pain in right inguinal and lumbosacral regions especially on resting improved on walking	

performed. A secondary operation was done 4 days later by perineal section—anastomosis of the urethra. The patient voided per urethra on the fifty third day and had an excellent result.

When the patients were discharged from the hospital, 21 were in excellent condition, 1 was fairly good, 1 was improved, 2 were fair and in 3 the result could not be accurately determined. One case had a poor result.

Six of the 35 patients died in the hospital making a mortality of 17 per cent. The causes of death may be enumerated as follows:

First case (a) multiple fractures of the pelvis (b) hematoma of the back which was incised and drained (c) streptococcus hemolyticus infection, and (d) secondary hemorrhage from back incision. Length of life 41 days.

Second case (a) multiple fractures of the pelvis (b) rupture of the urinary bladder (c) rupture of prostatic urethra and (d) infection of abdominal and perineal incisions and of the bladder. Length of life 14 days.

Third case (a) fracture of the left ilium (b) ruptured jejunum (c) acute diffuse peritonitis and (d) shock. Length of life 37½ hours.

Fourth case (a) separation of right sacro iliac joint and symphysis pubis (b) fracture both transverse processes of fourth lumbar vertebra (c) rupture of urinary bladder (d) hematoma of sacral region (e) abdominal wound infection and (f) cardiac decompensation which was the ultimate cause of death. Length of life 29 days.

Fifth case (a) multiple fractures of the pelvis and (b) fracture of the base of the skull. Length of life 16 hours.

Sixth case (a) multiple fractures of the pelvis, (b) fracture of transverse process of fifth lumbar vertebra (c) fracture of right sacrum (d) compound fracture dislocation of right astragalus (e) dislocation of right ankle joint.

(f) ruptured urinary bladder and (g) shock. Length of life 9 hours

Thus it will be seen that all of the fatal cases were definitely complicated, and that the fractures of the pelvis played but small part in the causation of death. The length of time in the hospital before death varied between 9 hours and 41 days, the average being 14.36 days.

Eighteen or 75 per cent of these cases were followed after discharge. We were unable to follow 6 cases. Eleven were in good condition, 2 in fair, 1 in poor, and 4 undetermined. Table V shows the type of work they are doing.

The late symptoms which these patients complained of are enumerated in Table XI. Pain seems to be the chief complaint.

Physical examination disclosed only slight deformity and bulging of the pelvis on one side, slight tenderness at the site of the fracture, and in one case there was shortening, this occurring in a fracture of the acetabulum. So, excellent results were seen in 6, good results in 9, in 2 of these there was a poor result due to a complication of the fracture, in 1 case the result was poor, and in 2 insufficient time has elapsed to determine the end results.

## THE VALUE OF THE WALCHER POSITION IN CONTRACTED PELVIS

WITH SPECIAL REFERENCE TO ITS EFFECT ON THE TRUE CONJUGATE DIAMETER

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THE Walcher position or the dorsal posture with the hips at the edge of the table and the lower extremities hanging over was used empirically to facilitate labor by Mercurio in 1589 and Mehl in 1738.

In his first communication in 1889 on the effect of posture on the measurements of the pelvis Walcher (30) reported measurements made on six pregnant women. They showed the diagonal conjugate to be increased from 8 to 13 millimeters by placing the woman on the edge of the table with the legs hanging down as compared with the measurements made with the legs flexed against the body. In his subsequent articles (31), he re-stated and commented on these findings without presenting new data. He believed that the softening of the pelvic joints during pregnancy permits the sacrum to become movable and allows the innominate bones to rotate downward so as to enlarge the diameters of the inlet.

In an article published recently (17) I offered the following conclusion among others:

'The Walcher position increases the anteroposterior diameter of the inlet from 0.5 to 1.0 centimeter. When the pelvis is slightly contracted or the fetal head is a little oversized in a normal pelvis the use of this position often facilitates engagement.

To my surprise I received a number of letters from physicians denying any material lengthening effect of the Walcher position upon the true conjugate diameter and, in some instances, any benefit in facilitating engagement of the presenting part. For this reason I thought it advisable to review the literature on the effects of the Walcher position notwithstanding the fact that practically all authors of textbooks on obstetrics concede its value in cases of relatively contracted pelvis.

## THE ACCEPTED VIEW

Polak states the generally accepted opinion as follows: "The posture of the patient has some influence on the diameters of the bony pelvis. When the thighs are extended, as in the Walcher position the upper end of the sacrum moves backward, while the symphysis is lowered and the brim is slightly increased in its anteroposterior diameter."

According to Shears "the engagement of the head in the pelvic brim is sometimes favored by placing the patient in the Walcher position. The space is small, 1 to 8 millimeters according to Pinzani, and few patients can be induced to maintain it for a long time but in doubtful cases it is worth trying.

Edgar offers the following explanation: The mechanism of the Walcher position is dependent upon the motion of the sacro iliac synchondrosis and is explained as follows: The weight of the limbs hanging from the edge of the table causes the ilia to rotate forward and downward around the transverse axis of the joint. Thus the angle made by the plane of the brim with the horizon is increased, and consequently the symphysis pubis is brought a little forward and downward, and a little further from the sacrum.

Tweedy and Wrench describe the effects of the Walcher position as follows: The weight of the lower limbs rotates the pelvis on the sacro iliac joints so that the pubic bone sinks. In this way the true conjugate is actually lengthened by half an inch, and this addition is of the greatest value.

Williams states that in cases of contracted pelvis in which engagement fails to occur after complete dilatation of the cervix the patient should be placed in Walcher's position for as long a time as she will bear it. In many cases this will bring about a lengthening of the anteroposterior diameter of the superior strait sufficient to permit engagement.

DeLee discusses the Walcher position as follows: "The true conjugate may be lengthened from 6 to 12 millimeters especially in flat pelvis. In a few cases I have gotten the head to enter the pelvis by this procedure but it is very painful and few women can be compelled to keep it up over 20 to 40 minutes. My results curiously have been better by the use of the exaggerated lithotomy position, which is theoretically contra-indicated because it contracts the inlet.

## REVIEW OF LITERATURE

Allen in 1891, substantiated Walcher's finding that the anteroposterior diameter of the pelvis can be altered by change in position and that it is longest in the position described by Walcher.

By measurements on the cadaver however he found that the conjugata vera was not increased in the Walcher position more than 0.64 centimeter in any type of pelvis. This increase was found in flat pelvis. In normal pelvis it was increased 0.54 centimeter. The average increase in 29 cases including normal and abnormal pelvis was 0.58 centimeter. Walcher pointed out, however, that Klein's measurements were made on the cadavers of non pregnant women, instead of on pregnant women, and that this fact might account for the lesser change in the true conjugate.

Duehrssen, in 1893, stated that his measurement of the conjugata vera in 6 cases in the dorsal and in the Walcher positions showed that in the latter the diameter was increased in length from 0.5 to 1.2 centimeters in all but 2 cases 1 centimeter or over. The greatest difference was found in a case with rachitic flat pelvis. He believed that this increase in the conjugata would be of definite advantage in cases of labor with contracted pelvis in which the head cannot be brought down into the pelvis rapidly enough in the usual dorsal position.

Kalt in 1894 reported 3 cases of narrow pelvis (conjugata vera 8 to 9 centimeters) in which the head could not be brought down into the pelvis until the patient was placed in the Walcher position. By this method a normal, living child was delivered in each instance.

Fehling in 1894 reported 3 cases of contracted pelvis in which the head was brought down into the pelvis and a living child was delivered by means of the Walcher position. The conjugata vera in these cases was not increased more than 6 to 8 millimeters by the Walcher position in comparison with the measurement in the dorsal position.

Wehle in 1894 reported 25 cases of contracted pelvis in which version and extraction were used in combination with the Walcher position. Of the 5 babies delivered, 3 were born dead and 3 died within a few days after birth, but, in one of the latter cases death could not be attributed to the method of delivery. Thus, of 25 children 0 (80 per cent) were safely delivered as compared with 68.4 per cent delivered previously by version and extraction without the use of the Walcher position. The transverse diameter of the head was in all cases larger than the conjugata vera measured in the dorsal position.

Fothergill in 1896 reported 11 cases of contracted pelvis in which the Walcher position resulted in the birth of a living child. In measurements of about 30 pregnant women made by

two independent investigators with the women in the lithotomy and the Walcher positions it was found that the average increase in the diagonal conjugate in the latter position was 1 centimeter. In 6 women with small pelvis the average increase in the Walcher position was 0.93 centimeter.

Huppert, in 1898, reported 28 cases of contracted pelvis in parturient women in which the Walcher position was used as an aid to delivery. In 18 of these cases a living child was delivered without operative interference. The conjugata vera in these cases measured in the dorsal position varied from 6.5 to 9 centimeters. The best results were obtained with flat pelvis. A smaller number of patients with generally contracted pelvis were delivered by this method. In every case the head of the child was larger by 0.5 to 1.5 centimeters than the conjugata vera measured in the dorsal position.

Kuettner in 1898, described a method for making plaster casts of the pelvis from the cadaver in various positions. From a study of the measurements of the pelvis by this method he found that the pelvis of the pregnant or puerperal woman showed definite changes in form and measurement in different positions. It was observed that the anteroposterior diameter of the pelvic inlet could be increased from 0.9 to 1.4 centimeters by the Walcher position, while, by flexion instead of extension of the thighs, the diameter of the outlet was increased. The transverse diameter was not altered in either case.

Cutts in 1899, maintained that, if there is to be any gain in the measurement of the superior strait, it must be sought in the principle set forth in the Walcher position i.e. the extension of the ilium on the sacrum. He noted that examination of the skeleton shows that the promontory of the sacrum is superior and anterior to the line representing the axis of rotation of the sacro iliac joints. When the thighs are extended, as in the Walcher position, the ilio pubic arch is rotated on the sacrum, so as to bring the symphysis pubis farther from the sacral promontory. In other words marked extension causes a lengthening of the true conjugate and, therefore aids engagement of the head in the superior strait, while marked flexion causes a lengthening of the anteroposterior diameter of the inferior strait.

Examining a female cadaver at the University of Minnesota laboratory, Cutts found that by actual measurement the true conjugate was 4.25 inches with the subject lying flat on the back.



In the Walcher position it was increased to  $4\frac{3}{8}$  inches. With marked flexion, it was diminished to 4 inches making the difference in the measurement between complete flexion and extension  $\frac{3}{8}$  inch. Cutts believed it quite probable that this measurement would be farther increased in the living pregnant state. While the difference of an eighth of an inch in the true conjugate between the dorsal position and the extended Walcher position is not much, yet it may be enough to aid materially in a high forceps operation. Cutts concluded that 'at least some cases of dystocia at the superior strait will be benefited by the Walcher position.'

Dickinson, in 1899, from his study of the effect of posture on the shape of the pelvis in late pregnancy, came to the conclusion that the hanging dorsal posture should be employed to obtain the longest conjugate at the inlet and that the gain is nearly 1 centimeter.

Dice, in 1911, discussing methods of determining the relative size of the head and the pelvis prior to term, stated 'If the patient is put in the Walcher position the maximum enlargement of the inlet is secured.'

Christiani, in 1913, reported that in a series of 45 cases of contracted pelves the Walcher position was of definite aid in bringing the fetal head down into the pelvis in 11 instances. In 9 cases it had no effect on the progress of labor. He believed that it should be tried in any case in which the discrepancy between the size of the pelvic inlet and the fetal head is not too great and progress of the head is stopped at the inlet. In some cases he thought that the position not only facilitates the passage of the head into the pelvis but also appears to strengthen the pains.

Martin in 1925, stated that the Walcher position aids delivery in cases of contracted pelvis. He considered that enlargement of the pelvic diameter by only a few millimeters may be sufficient to allow the head to pass especially with the aid of proper manipulation.

Krukenberg in 1926, noted that the Walcher position is of definite value as an aid to labor when there is but slight disproportion between the size of the head and of the pelvis. In such cases the increase of 0.75 to 1 centimeter thus obtained in the conjugata vera is sufficient to aid delivery. At any rate he believed that the effect of this position should be tried, as it does no harm.

#### DIRECT MEASUREMENT OF THE TRUE CONJUGATE

One source of contradiction with regard to the effects of the Walcher position on the conjugata vera arises from the methods clinically employed

to determine this diameter. It has been generally assumed that an accurate estimation of the true conjugate can be made by measuring the diagonal conjugate and by making an appropriate deduction according to the estimated height, thickness, and inclination of the symphysis pubis. Yet some recent observations would suggest that this rough method of judging the true conjugate may sometimes be inaccurate.

Dr J. Bay Jacobs, of Washington, has devised a new obstetric inclinometer, by which the obstetrical diameters, the inclination of the pelvis as a whole, and the angulation of the various planes may be read directly on the instrument and with great precision. With this inclinometer he visualizes the interior of the pelvis in terms of an *obstetric triangle*, formed by the symphysis pubis, the true and the diagonal conjugate.

'Studies with the inclinometer,' writes Jacobs (15), 'indicate that our ordinary method of computing the true from the diagonal conjugate has frequently caused an underestimate of the degree of pelvic contraction. In some instances what appears to be a border line case proves to be one of absolutely contracted pelvis when studied with the aid of the obstetrical inclinometer.'

At my request Dr Jacobs (16) was kind enough to make observations with his inclinometer in 10 cases of contracted pelvis. I regard his findings as of great importance since they give direct measurements of the true conjugate whereas in most previous reports the true conjugate was estimated from the diagonal by the ordinary clinical method. I quote from Dr Jacobs' letter:

Of a series of 10 patients whose measurements were taken with the obstetrical inclinometer, 9 had moderate and 1 absolute pelvic contraction. The observations were made with the patient first in the dorsal recumbent and then in the Walcher position.

In all cases the Walcher position caused an increase in the diagonal conjugate varying from 0.3 to 2 centimeters. In the majority however the increase was 0.5 to 1 centimeter.

The effect of the Walcher position on the true conjugate however depends on the consequent variation in size of what I term the obstetric angle (included between the symphysis pubis and the diagonal conjugate) and the lengthened diagonal conjugate.

The change in the length of the true conjugate varied from minus 0.3 centimeter to plus 2.1 centimeters. In one case the Walcher position caused a decrease of 0.3 centimeter in the conjugata vera; in another case there was no change. In the 8 remaining cases the true conjugate was increased by 0.3 0.7 0.95 1.1 1.6 1.8 1.9 and 2.1 centimeters respectively.

Dr Jacobs' observations are important because they show by exact measurement of the

true conjugate that the anteroposterior diameter of the inlet is generally increased by the Walcher position but that it may sometimes be unaffected or even slightly reduced

#### ROENTGEN PELVIMETRY

Another method of making exact measurements of the inlet that might be utilized for studying the effects of the Walcher position, and probably will be in the near future, is roentgen pelvimetry. Satisfactory methods proved by comparison with the cadaver to be exact have been described by Bell, Thoms, Dorland Heublein, Roberts, and Ogden, and by Coats.

Concerning his observations with roentgen pelvimetry, Thoms (28) writes as follows:

When one considers the quite inadequate information concerning the superior strait that is derived from the ordinary methods of pelvimetry it is surprising that more attention has not been given to pelvimetry by means of the roentgen ray. I think it is safe to say that the maneuver of most value today is the one that was described nearly 200 years ago by William Smellie. I refer to the method of estimating the diagonal conjugate diameter. The other maneuvers usually practiced in estimating the size of the pelvic inlet are inexact and unreliable. Not only does roentgen pelvimetry afford an exact knowledge of the anteroposterior diameter but the transverse diameter also becomes available.

#### MANNER OF USING WALCHER POSITION

To be effective, the Walcher position must be maintained sufficiently long. If the patient's legs are allowed to hang over the table without support, this posture is likely to prove uncomfortable and cannot be maintained for more than 5 to 10 minutes. However, if the feet are supported properly, it may be held without too great discomfort for as long as 45 minutes.

In order that the patient may be kept in the Walcher position long enough to facilitate engagement of the presenting part, I have designed and utilized an obstetric table equipped with a shelf on a sliding rack that can be adjusted exactly to fit the height of the patient (17). In the home, the patient can maintain the Walcher position comfortably by placing her feet on a foot stool or cushion adjusted to the proper height.

#### SUMMARY

The consensus of opinion as stated in authoritative textbooks on obstetrics is that the use of the Walcher position in contracted pelvic conditions lengthens the anteroposterior diameter of the inlet sufficiently to help engagement. From a careful study of the literature and observations on 7 cases by direct measurements of the true

conjugate with an obstetrical inclinometer, it would appear that this view is substantially correct.

However, several qualifications should be stated. In a minority of cases, the Walcher position may not change the length of the conjugata vera or even reduce it. Also, it is necessary to bear in mind that estimations of the true conjugate from the diagonal may be misleading and what appears to be a case of relatively contracted pelvis may really be one of absolute contraction.

Nevertheless there is no valid reason to doubt the efficacy of the Walcher position in many cases of minor degrees of pelvic contraction. Its use frequently avoids the necessity of surgical intervention.

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## EDITORIALS

### SURGERY, GYNECOLOGY AND OBSTETRICS

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DECEMBER, 1929

### THE DIAGNOSTIC VALUE OF MICROSCOPIC EXAMINATION OF FROZEN FRESH TISSUE

THE evolution of the fresh frozen section has been dramatic in its relation to the advance of surgery.

With the old method, preserved material with its artefacts was examined at the end of from 4 days to 2 weeks, at a time when it was of comparatively little use to the patient. Not only does the frozen section make possible an immediate diagnosis, but in malignant disease, through the work of MacCarty and Broders, it gives the grade of malignancy. Knowing the nature of the pathological process, the surgeon has a much better conception of the life expectancy of the patient and is guided in his choice of a radical or palliative operation. For instance, in a malignant growth graded 4 by Broders' classification, the prospects of surgical cure might not balance the immediate risk of the operation, whereas the nature of the growth might be such that other methods of treatment, radiotherapy or heat, would give a far greater chance of recovery.

The history of the frozen section is not concerned with the question of priority of discovery or application of the method, but is merely the story of how it was worked out in one hospital clinic. For the application and success of the method here, credit is due Dr. Louis B. Wilson, who devoted one of his earliest researches to the development of microscopic examination of frozen fresh tissue.

In 1905, Dr. Wilson, who had been an associate in the Department of Pathology at the University of Minnesota, came on to the staff at St. Mary's Hospital in Rochester as chief of the Department of Pathology. Previous to entering on the study of medicine, he had received a long training in physics, biology, and botany. He proceeded to put the pathological laboratories on a scientific basis.

In his work in surgical pathology, Dr. Wilson soon saw the desirability of an immediate microscopic examination of tissues removed at operation and tried out a number of methods of cutting and staining sections for this purpose. His first sections were cut by hand between pieces of elder pith or fixed liver, methods with which he had been familiar as a botanist. His first frozen sections were made by putting the tissues outside the window when the weather was 20 degrees below zero in January, 1905. He then tried out various methods of freezing with ether, with which he had experimented while at the University of Minnesota. In 2 or 3 months, however, he found the method of freezing with carbon dioxide on a Spencer microtome to be the most satisfactory after making some modifications of the freezing chamber of the microtome.

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Over 60 years ago Virchow said, "all so called varieties of goiter are none other than different terminal metamorphoses of a single type, and a large and striking variety of pathological changes may be combined in the same goiter." Although Virchow, Kocher, and other more recent students of the problem denied the existence of a definite histologic picture in toxic goiter, the view that hyperplasia is constant and specific has been supported by a great many investigators, notably MacCallum, Lewis, Ewing, Iarner, and Wilson.

Some newer conceptions of thyroid pathology, although by no means generally accepted, are (1) Although hypertrophy and hyperplasia are usually associated with toxic goiter, they may be present without associated systemic symptoms. (2) Colloid goiter is a resting stage of hyperplasia, and is preceded by the latter (Marine). (3) Nodular goiter, "involutional bodies," "involutional cysts" etc (Rienhoff) follow hyperplasia and are invariably preceded by it. (4) Toxic adenoma, "hyperfunctioning adenoma," is an entity distinct from exophthalmic goiter (Plummer) and, *per contra*, toxic adenoma and exophthalmic goiter are but different phases or manifestations of the same disease (Graham, Cutler, Hertzler). (5) Iodine, obviously helpful in the relief of symptoms associated with true exophthalmic goiter, produces no such effect in "toxic adenoma," rather being definitely harmful in such condition. (6) If toxæmia is not already established in an adenomatous goiter, iodine administration will cause an activation of the quiescent gland resulting in the toxæmia of "hyperfunctioning adenoma (Plummer) or 'iodine hyperthyroidism' (Jackson). (7) Nothing has been discovered to prove that an adenoma, apart from typical hyperplastic Graves disease, is capable of producing a separate and distinct syndrome in which iodine is less beneficial

than in the exophthalmic form (Graham). (8) Exophthalmic goiter and toxic adenoma are clinical variations of a single morbid state (Graham, Warthin). (9) Relatively few so called adenomata are adenomatous at all, as they form but a small percentage of all goiters (8 per cent, Rienhoff). (10) Deliberate efforts to produce, by the administration of large quantities of iodine, that state referred to as "toxic adenoma" have singularly failed, thus disproving the existence of such an entity as iodine Basedow or iodine hyperthyroidism (Graham and Cutler). (11) All cases of Graves' disease and so called toxic adenoma possess an identical underlying constitutional abnormality, which is manifested by the constant presence of hyperplastic lymph nodules with large germinal centers. These individuals belong to the "thymicolymphatic diathesis" (Graves' constitution, Warthin), and are, consequently, predestined from birth to hyperthyroidism if the necessary stimuli (physical or emotional stress, infection, etc.) are supplied.

Warthin states that our conception of hyperthyroidism has become an enlarged clinical syndrome, to which innumerable symptoms are daily added until it has become "impossible to distinguish between what some writers regard as exophthalmic goiter and what others call toxic adenoma, and that the pathologist encounters great difficulties if he attempts to apply the histological criteria commonly used for the diagnosis of exophthalmic goiter, hyperthyroidism, or toxic adenoma."

There lurks in all this some truth, much that is difficult of comprehension, some that must be fallacious. We have, however, progressed far, but a solution of the problem of the etiology of goiter probably must be found before thyroid pathology can be more perfectly understood.

HAROLD L. FOSS

He had been using Bethe's methylene blue for vitally staining nerve endings for some time and found that it gave excellent results on excised fresh tissue also. Brun's glucose mounting medium he had used years before for botanical preparations.

After getting the method on a satisfactory basis, he used it for several months and then described it in December, 1905, in the *Journal of the American Medical Association*. He published a more complete article in 1915 in the *Journal of Laboratory and Clinical Medicine*. There have been a number of slight modifications of the method since it originally was published, but the essential principles are the same. Perhaps no better results have been obtained by any of the modifications. They have been rather along the line of short cuts and methods for the preparation of polychrome and methylene blue.

For years Dr. Wilson checked all his diagnoses made on fresh tissues by the subsequent examination of sections from the same source made from fixed tissues. As one gathers experience this checking is usually unnecessary. Indeed, MacCarty and Broders from their long experience feel as much confidence in their diagnoses on fresh tissue as on fixed.

Pathologists about to begin the study of fresh tissue should always be cautioned on the importance of preparing sections from fresh tissue immediately after its removal, of making several sections of each block so that they may come to know what is a good preparation, and above all, of making a practice of examining blocks from every bit of fresh material available, even though they are certain it is normal, so that they fix in their minds the appearance of normal tissues when stained by this method and thus have a proper background for the recognition of pathological tissues.

Increasing use is being made of this most valuable method of microscopic examination of frozen fresh tissue, which gives a reliable diagnosis from living tissue within 2 or 3 minutes of the time it is removed—in time to be of benefit to the patient. The fresh frozen section has come into its own.

W. J. MAYO

## THE PATHOLOGY OF TOXIC GOITER

IT is generally believed (1) that the thyroid shows, in toxic goiter (hyperthyroidism, Graves' disease, thyrotoxicosis, exophthalmic goiter), parenchymatous hypertrophy and hyperplasia, (2) that iodine administered in any form is rapidly taken up by the hyperplastic gland and that involution changes follow, reducing it to a phase analogous to the resting or colloid state, (3) that there is a corresponding amelioration of all systemic manifestations, marked especially by a reduction toward normal in respiratory exchange, heat production, and oxygen consumption (basal metabolism), (4) that these results are but temporary, that in spite of continued iodine administration there is, in most cases, a gradual return of hypertrophy and hyperplasia, with a parallel recurrence of systemic symptoms characterized especially by a rise in metabolism, (5) that the iodine content of the gland is inversely proportional to the degree of hypertrophy and hyperplasia, and that this ratio holds true for all animals from fish to man, (6) that, histologically, nodular goiter is not usually "adenomatous," but that the majority of nodular masses within a goitrous thyroid show little glandular tissue and are in no sense epithelial tumors, or "adenomata," but rather cysts or collections of colloid or circumscribed masses of subinvolved thyroid.



ELIAS COOPER  
18. - 1862



# MASTER SURGEONS OF AMERICA

## ELIAS SAMUEL COOPER

**E**LIAS SAMUEL COOPER was emphatically a surgeon. In fact he was known to have somewhat bombastically stated that surgery was the only career worthy of a man. Daring as a surgeon, as a man a fighter, a demon for work, endowed with great originality, he was little short of a surgical genius.

He is generally credited with having been the first, west of Pennsylvania, to have used chloroform as an anesthetic and was further distinguished by having founded the first medical college on the Pacific Coast. He was a brother of Dr. Esaias Cooper, of Galesburg, Illinois, and of Jacob Cooper, professor of Greek and later of philosophy in Rutgers College, New Jersey.

Born in Somerville, Ohio, in 1832, he began the study of medicine in Cincinnati at the age of 16 years, and was graduated from the St. Louis University 2 years later. He began practice in Danville, Ohio, but in 1844 moved to Peoria, Illinois, where he built the first hospital in that city which he called his "Eye and Ear Infirmary and Orthopedic Hospital," a three story building on what was at that time called the prairie about one mile from the edge of town and was called by the children "The Spook House." His office was in the center of town in one of the very few brick buildings. On the second floor he established an anatomical museum and dissecting room, where he labored far into the night to perfect himself in the anatomy of his operative fields. Doubtless the cadavers were surreptitiously obtained, there being no anatomical law at that date. Some supersensitive citizens resented the row of human skeletons which lined the wall and when the County authorities publicly turned over to Dr. Cooper for dissection, the bodies of two murderers—victims of the first execution in Knox County—a mass meeting of irate citizens was held in protest, but the meeting broke up in an uproar and the matter was quashed. Dr. Cooper, however, found it convenient to arrange for his future dissections at his hospital, which was just out of town.

His life in Illinois was strenuous, to say the least, and the minutes of the Peoria Medical Association have many allusions to Dr. Cooper. On one occasion, in 1850, he was "profoundly reprimanded and requested to resign" because of unethical conduct in advertising his Infirmary. Notwithstanding this criticism, in 1851, he was delegate (alternate) to the American Medical Association. In

1852, he was secretary of the Illinois State Medical Society, a member of the Committee on Legal Dissection in 1851 and 1852. In 1853 he was president of the Knox County Medical Society.

He presented many papers e g, in 1851 he read a paper entitled "Chloroform as an Anæsthetic Agent in 79 Surgical Operations," and in 1852 one on "Treatment of Incomplete Ankylosis of the Knee Joint."

In 1854 he went to Europe visiting various clinics.

In 1855 at the age of 33, Dr. Cooper went to California where he was almost immediately active in the organization of a state medical society. He was said to have been one of the committee who issued the invitation to the medical profession to assemble for that purpose. At the first meeting, 1856, he offered the following preamble and resolution.

WHEREAS, The laws of our State render surgeons obnoxious to prosecution and liable to heavy damages if they operate wrongfully, through ignorance, at the same time making no adequate legal provision for obtaining a knowledge of the human system therefore be it

RESOLVED That in view of the good of the profession, as well as the community, dissections should be legalized under all proper restrictions.

RESOLVED That a committee of five (5) be appointed to memorialize the Legislature upon the subject.

He also read a paper on "Gradual Obliteration of the Abdominal Aorta," having devised an instrument for that purpose and used it with encouraging success in animal experimentation. One animal (dog) lived four days after the occlusion of the aorta was complete. At the second meeting, 1857, Dr. Cooper, being vice president, presided in lieu of Dr. B. F. Keene (deceased) and gave the presidential address on "Deformities of the Locomotive Apparatus." At the third meeting, in 1858, he read a paper on "Ligating the Satellite Veins in Connection with the Arteries which they Accompany," reporting a case of ligation of the iliac artery with experimental ligation with and without ligation of the accompanying veins in some fifteen dogs.

Dr. Cooper early sprang into prominence in California as a result of an operation for the removal of the breech pin of a fowling piece from beneath the heart. He was the first to perform cæsarean section in California and his patient survived (two cases, in fact, the first leading to a most viciously fought malpractice suit, which, however, was finally won by Dr. Cooper). He declaimed against the accepted doctrine of the danger of the entrance of "atmosphere" into joints, advocated the wide opening and packing with lint of infected joints and those the seat of penetrating wounds. He successfully sutured the fractured olecranon and patella with silver wire, was an enthusiastic advocate of early functional demand in the fractures of the lower extremities, operated for club foot by cutting the contracted soft parts on the short side, as was done by Phelps of New York 40 years afterward, holding the foot subsequently in molded sheet lead, for plaster



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of Paris bandages had not yet been invented. He announced a new cure for aneurism by cutting down on the sac and sewing it up with needle and thread from the outside. He did much operative work on the eye, even iridectomy and removal of cataract. He successfully removed uterine myomata. He also ligated the innominate artery, his patient living 41 days. He removed a sarcoma of the clavicle taking with it a portion of the sternum.

Much of Dr. Cooper's operative success was due to his free use of alcohol on instruments and hands and parts to be operated on and for the irrigation of wounds, although he was inclined to account for the fact that his wounds did better in California than in Illinois by the difference in climate, or rather that the combination of climate and alcohol had a most remarkably favorable influence in the healing of wounds.

Chloroform was the anæsthetic used—administered on rather coarse sea sponges—perhaps 5 inches in diameter hollowed out on the side toward the patient's face. The mortality was high.<sup>1</sup>

In 1858 Dr. Cooper founded, in San Francisco, the first medical college on the Pacific Coast. In default of a charter an affiliation was made with the University of the Pacific, a Methodist college at Santa Clara, California, by which the school secured the right to issue diplomas. The school received much criticism and ridicule but by persistence, devotion, and good work on the part of the Faculty succeeded in winning the respect of the community.

In the announcement of the first course of lectures to students which began May 12, 1859, occurs the following remarkable proposal for the course in surgery:

'First A regular course of lectures on the principles and practice of surgery second demonstrative surgery upon the cadaver, third experimental surgery by vivisection, in which many of the most important principles are indelibly impressed upon the mind of the student. Members of the class are permitted to assist in these experiments upon animals and afterward expected to repeat them under the eye of the professor of surgery. This is an exercise above all others calculated to school the hand, the nerve and the eye of the pupil and thereby give him the experience he at once requires in performing the duties of an operative surgeon—a feature in medical education however, almost entirely neglected in many other medical schools.

Of his own experiments on dogs, the admission of air into the jugular vein and the subsequent resuscitation of the dog by aspiration of the froth from the ventricle is not the least remarkable.

As a result of a controversy with the editor of the *Pacific Medical and Surgical Journal* over the first cesarean section, and in order to find a medium of publication for his contributions, Dr. Cooper began publishing the *San Francisco Medical Press*, a quarterly journal of medicine and surgery. After Dr. Cooper's death this journal was continued by Dr. L. C. Lane and Dr. Henry Gibbons.

Most of Dr. Cooper's contributions are to be found in the *Transactions of the Illinois State Medical Society*, the *North Western Medical and Surgical Journal*,

<sup>1</sup> Personal communication with exhibition of the sponges by Dr. W. A. C. over who gave many anæsthetics for Dr. Cooper.

*California State Medical Journal*, 1856, *Transactions of the Medical Society of the State of California*, 1858, *Pacific Medical and Surgical Journal* and *San Francisco Medical Press*

Dr Cooper never married. He died October 13, 1862 at the age of 40, most probably of nephritis. His heart and brain were preserved by Dr Lane in a kind of shrine in an inner sanctum in Cooper Medical College.

Dr Cooper was buried in Laurel Hill Cemetery, San Francisco, where a granite shaft carries the simple legend without date:

Sacred to the memory of  
Flias S Cooper  
Surgeon

The school lapsed in 1864 but was reorganized under the title Medical College of the Pacific in 1870 and later as Cooper Medical College by Dr Cooper's nephew, Dr Levi Cooper Lane, who at his personal expense built a commodious building in 1880 renaming the institution in honor of his uncle.

In 1909 the properties of Cooper Medical College were donated to Stanford University and became the nucleus of the newly organized medical department of the University.

EMMET RIVFORD

NOTE.—There is some discrepancy between two records of the date of Dr Cooper's birth. That given above 1822 was taken from the obituary notice at the hand of his nephew and associate, Dr L. C. Lane in the *San Francisco Medical Press* 1862, and is presumably the date understood by Dr Cooper himself. A younger brother, however, gave the date as November 25 1820.

# THE SURGEON'S LIBRARY

## OLD MASTERPIECES IN SURGERY

ALFRED BROWN M.D. F.A.C.S. OMAHA, NEBRASKA

### THE NATURAL HISTORY OF PLINY THE ELDER

**G**AIUS Plinius Secundus known as Pliny the Elder was the son of a Roman knight and his wife, the daughter of the senator Gaius Caelius. He was born at Comum about 23 A.D., and attained his desire for study after being taken to Rome by his father and educated under P. Pomponius Secundus the poet and soldier. His education was that of the noble of his day colored by the decline of Rome, and consequently his book does not show the clear diction of earlier Rome but evinces a lack of clarity of phraseology which he tries to cover up by ambiguity and extravagant language.

Pliny became the friend of emperors and held many important offices in the Roman Empire. He traveled widely and saw many important events. He studied rhetoric under Seneca, practiced as an advocate, served as a military commander, saw service in many campaigns, and, finally, became prefect of the Roman fleet at Misenum in 77 A.D. Here he was stationed in 79 A.D. when on the twenty-fourth day of August, Vesuvius erupted and covered the towns of Pompeii and Herculaneum. Though in safety his desire on the one hand to observe this great cataclysm of nature at closer quarters and on the other to rescue some of his friends led him to cross the bay and enter the danger zone where he lost his life in his fifty-sixth year.

In spite of his busy life as a citizen and officer of the Roman Empire, Pliny found time for continuous reading and study. His life is an excellent example of the fact that a man with a card catalogue type of brain and endowed with enormous energy can accomplish much. He read incessantly. In the preface of the *Natural History* he claims that he states twenty thousand facts derived from two thousand works that he has read. His nephew Pliny the Younger said of his uncle: "He began to work long before daybreak. He read nothing extracts." It is said that the notes from which the *Natural History* was written occupied practically one hundred and sixty volumes which must have been indexed and cross indexed perfectly, for the work was written in two years.

In various parts of the work, Pliny mentions diseases in passing and shows that he was versed in the common knowledge of the day. He knew

quite a bit concerning diseases of the eye, speaks of caesarean section, mentions an artificial hand of iron to replace one that M. Sergius lost in battle and describes a case of empyema cured by a stab wound.

In his twenty-sixth book Pliny discusses new diseases which had lately come to the notice of the people of the Roman Empire and from his description one would gather that he considered the various forms of leprosy as different diseases and gave them the names of lichen, *lascivia mentagra*, *carbunculus*, and *elephantiasis*. He says: "The countenance of man perceives new diseases wholly unknown in previous times, not only in Italy but in almost all of Europe. Then they wander much through all Italy, and through Illyria, Gaul or Spain or elsewhere, even around Rome. One of these diseases is without pain and without danger to life, but of such foulness that death is preferable to whoever has it. This most grave disease is called 'lichen' the name in Greek, in the Latin as it almost always begins on the chin, it was first jokingly called *lascivia* (as is the insolent nature of many in the misfortunes of others) soon it was called *mentagra*. The scab in many cases occupies nearly the entire face the eyes being immune and descends to the neck, chest and hand as a foul rash of the skin. This *lues* (pestilence) was not present among our great fathers. It first appeared in Italy in the middle of the reign of the emperor Tiberius Claudius according to a certain knight Perusinus a Roman quaestor who wrote of it after it had appeared in Asia whence the contagion was imported to us."

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# THE SURGEON'S LIBRARY

## OLD MASTERPIECES IN SURGERY

ALFRED BROWN M.D. F.A.C.S. OMAHA, NEBRASKA

### THE NATURAL HISTORY OF PLINY THE ELDER

**G**AIIUS Plinius Secundus, known as Pliny the Elder, was the son of a Roman knight and his wife the daughter of the senator Gaius Cæcilius. He was born at Comum about 23 A.D., and attained his desire for study after being taken to Rome by his father and educated under P. Pomponius Secundus, the poet and soldier. His education was that of the noble of his day, colored by the decline of Rome and consequently his book does not show the clear diction of earlier Rome but evinces a lack of clarity of phraseology which he tries to cover up by ambiguity and extravagant language.

Pliny became the friend of emperors and held many important offices in the Roman Empire. He traveled widely and saw many important events. He studied rhetoric under Seneca, practiced as an advocate, served as a military commander, saw service in many campaigns and finally became prefect of the Roman fleet at Misenum in 77 A.D. Here he was stationed in 79 A.D. when on the twenty-fourth day of August, Vesuvius erupted and covered the towns of Pompeii and Herculaneum. Though in safety, his desire on the one hand to observe this great cataclysm of nature at closer quarters and on the other to rescue some of his friends led him to cross the bay and enter the danger zone where he lost his life in his fifty-sixth year.

In spite of his busy life as a citizen and officer of the Roman Empire, Pliny found time for continuous reading and study. His life is an excellent example of the fact that a man with a card catalogue type of brain and endowed with enormous energy can accomplish much. He read incessantly. In the preface of the *Natural History* he claims that he states twenty thousand facts derived from two thousand works that he has read. His nephew, Pliny the Younger, said of his uncle: 'He began to work long before daybreak. He read nothing extracts.' It is said that the notes from which the *Natural History* was written occupied practically one hundred and sixty volumes which must have been indexed and cross-indexed perfectly for the work was written in two years.

In various parts of the work Pliny mentions diseases in passing, and shows that he was versed in the common knowledge of the day. He knew

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## REVIEWS OF NEW BOOKS

THE subject matter of Das's book on obstetrics<sup>1</sup> is treated chronologically and is divided into 11 sections. The first section considers the question whether the ancients possessed any conservative instrument similar to the obstetric forceps of the Chamberlens.

The second section is devoted to the Chamberlens and is a résumé of Aveling's wonderful work. The third section contains as a natural sequence the history of the forceps in Holland. The fourth section deals with the eighteenth century forceps.

The subsequent sections deal with successive periods of half or quarter centuries ending with the first 28 years of the twentieth century.

Whenever available the inventor's own original descriptions have been reproduced. An attempt has also been made to give a short note of their life and work.

Section IX gives a review of the attempts that have been made from time to time to classify forceps. Section X contains chronological lists of forceps together with a résumé of a chronology of founders of forceps compiled by Alban Doran. In Section XI, an attempt has been made to collate and record references and illustrations regarding forceps (or founders of forceps) in allegory, literature and art.

Then follows the appendix of measurements. The list of references form the concluding section.

One may gain an idea of the amount of labor necessary to complete this work when it is stated that there are 2,072 references listed. Everyone interested in obstetrics should read this book.

E. I. CORNELL

THE author opens the introduction to this small volume<sup>2</sup> with the following statement. By the term *Toxemias of Pregnancy* is usually understood a group of disorders associated with gestation which account for about 26 per cent of the total maternal mortality incident to child birth. To classify correctly, determine the etiology of and successfully treat these disorders has been and still is one of the most important problems in obstetrics. He then proceeds to give in detail the changes which occur during normal pregnancy.

The toxemias of pregnancy are classified under six headings as follows: vomiting of pregnancy, low reserve kidney, nephritis complicating pregnancy, pre-eclampsia, eclampsia, and acute yellow atrophy of the liver.

The etiology of eclampsia is very well written. It is divided into twenty-two subdivisions and the arguments for the belief that the disease is the result of these twenty-two factors is given. We read on

and find that the subject is still unclarified. The reviewer had hoped that Stander would clear up the confusion of ideas regarding the etiology of this dreadful disease.

The book is well written and systematically planned. It is a book which everyone doing obstetrics should read and study.

F. L. CORNFEL

IN offering to the medical world one more treatise on pathology, it would seem necessary if not to make an apology, at least to give an explanation. I owe and Hala in the preface to their work<sup>3</sup> on this subject. The explanation or apology for presenting this volume of 787 pages to the medical world is that the authors feel that the requirements for a single textbook have not been met from the instructor's standpoint. They have endeavored to present "our knowledge, and particularly our understanding, of pathological processes and changes concisely and consequentially, concentrating on the diseases that are likely to come within the range of general practice and relegating rarities to brief reference. On the whole the authors have produced a textbook which fulfills these conditions. It is readable and in general clear. The arrangement is somewhat different from that of the usual textbooks as, for instance, the omission of circulatory disturbances from Part I on General Pathology and the inclusion of them under the Diseases of the Vascular System in Part II Systematic Pathology. Of the 208 illustrations many are not only diagrammatic but are distinctly crude in their execution and they certainly do not constitute the most commendable feature of the book. The bibliography is very meager.

While this volume has some merits, they can hardly be said to be so outstanding as to warrant its replacing any one of the several textbooks on the subject already available.

J. P. S.

THIS small volume<sup>4</sup> of 119 pages is a translation of an article by Professor Boveri which appeared some fifteen years ago. The author writes on the problem of the origin of malignant tumors as a zoologist. He admits having had "no experience to speak of in any of the numerous special fields of tumor research." The essence of his conception is "the cell of a malignant tumor is in some way a defective cell, it has lost some qualities of normal tissue cells. The defect inheres in the nucleus. It has not abnormal mitosis but in general, a definite abnormal chromosome complex. This thesis is developed largely on the results of study of sea urchin eggs and of other lower forms of life. This

<sup>1</sup>OBSTETRIC FORCEPS: Its History and Evolution. By Kedarnath D. C. L. B. M. D. Calcutta. The Art Press 1929.

<sup>2</sup>MEDICINE MONOGRAPHS. Vol. 9.—The Toxemias of Pregnancy. By H. J. Stander. Baltimore. The Williams & Wilkins Company 1929.

PRINCIPLES OF PATHOLOGY FOR PRACTITIONERS AND STUDENTS. By H. D. Arcey, M. D. F. R. C. S., and William N. Hala, M. D. New York and London: D. Appleton and Company 1929.

<sup>4</sup>THE ORIGIN OF MALIGNANT TUMORS. By Theodor Boveri. Translated by Marcella Boveri. Baltimore: The Williams & Wilkins Company 1929.



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discussion will be interesting to cytologists and to those who are specializing in cancer research. Its interest to a practicing surgeon will probably be small  
J P S

THE third volume of the *Oxford Monographs on Diagnosis and Treatment* by Dr Henry A. Christian is an authoritative clinical discussion of heart disease. It is, moreover, frank, clear, simple, and practical. It is of interest to note that it does not contain a single electrocardiogram or polygraph tracing. This is characteristic of the bedside point of view emphasized throughout the book. In regard to these he says, "These instruments often help but they are not indispensable, and without them the trained clinician can render to his patients satisfactory service in both diagnosis and treatment."

The intelligent co-operation of the surgeon and internist is frequently mentioned, especially as regards cardiac complexes giving abdominal symptoms, postoperative care and the surgical treatment of hyperthyroidism. For instance, "It would seem

*OXFORD MONOGRAPHS ON DIAGNOSIS AND TREATMENT* Edited by Henry A. Christian M.D., Sc.D., LL.D. Vol. III—THE DIAGNOSIS AND TREATMENT OF DISEASES OF THE HEART. By Henry A. Christian M.D., Sc.D., LL.D. New York: Oxford University Press, 1928

that many surgeons are unaware that cardiac action may simulate so closely abdominal lesion and "Intelligent close co-operation between clinician and surgeon is essential for success in treatment of patients with hyperthyroidism and disability."

Perhaps the most striking quality of the text casting aside of old textbook errors and the analysis of difficult questions, the sound advice given on every page, for example, in murmurs: "The American physician still so obsessed by the idea of the importance of murmurs that it is difficult for him to admit of failure without murmurs and equally difficult for him to recognize that an entirely normal heart may show a loud systolic murmur."

I am impressed with the usefulness of these monographs which have thus far been received the first four volumes out of ten. They are short, very practical, complete in that they are the full personal work of their authors. This volume on the heart read to advantage by everyone—student, physician, surgeon, or professor of medicine.

PAF

## BOOKS RECEIVED

Books received are acknowledged in this department and such acknowledgment must be regarded as a sufficient return for the courtesy of the sender. Selections will be made for review in the interests of our readers and as space permits.

THE FEMALE SEX HORMONE. PART I—BIOLOGY, PHARMACOLOGY AND CHEMISTRY. PART II—CLINICAL INVESTIGATIONS BASED ON THE FEMALE SEX HORMONE. BLOOD TEST. By Robert T. Frank, A.M., M.D., F.A.C.S. Springfield, Illinois and Baltimore, Maryland: Charles C. Thomas, 1929.

PRACTICAL LOCAL ANESTHESIA AND ITS SURGICAL TECHNIQUE. By Robert Emmett Fair, M.D., F.A.C.S. 2d ed. Philadelphia: Lea & Febiger, 1929.

SURGICAL DISEASES OF THE THYROID GLAND. By E. M. Ebert, M.D., with the assistance of R. R. Fitzgerald, M.D., and Philip G. Silver, M.D. Philadelphia: Lea & Febiger, 1929.

AN INTRODUCTION TO THE STUDY OF THE NERVOUS SYSTEM. By J. F. Harker, D.Sc. (Lond.) and G. M. Sanders, M.B., B.S. (Lond.) M.R.C.S., L.R.C.P. St. Louis: The C. V. Mosby Company, 1929.

THE BLOOD PICTURE AND ITS CLINICAL SIGNIFICANCE (INCLUDING TROPICAL DISEASES). A GUIDEBOOK ON THE MICROSCOPY OF BLOOD. By Professor Dr. Victor Schilling. Translated and edited by R. B. H. Gradwohl, M.D. 7th and 8th rev. ed. St. Louis: The C. V. Mosby Company, 1929.

POSTURE AND HYGIENE OF THE FEET. By Philip Lewis, M.D. The National Health Series. Edited by the National Health Council. New York and London: Funk & Wagnalls Company, 1929.

THE MEDICAL RECORD VISITING LIST OR DIARY FOR 1930. Rev. New York: William Company, 1929.

GASTRIC AND DUODENAL ULCER. By Arthur M. A. M.D. (Oxon.) F.R.C.P. and Matthew M.B. (Glasg.) F.R.C.P. with the co-operation of the Logical Sections of P. J. Briggs, M.A. (Cantab.), L.R.C.P. New York and London: Oxford Press, 1929.

ROUTINE PROCEDURES AND FORMULARY FOR GENERAL HOSPITAL. Kansas City: Printing S. 1929.

THE PATHOLOGY OF THE EYE. By Jonas S. F. A.M., M.D., F.A.C.S. New York: The Macmillan Company, 1929.

SYNOPSIS OF MIDWIFERY AND GYNECOLOGY. W. Bourne, B.A., M.B., B.Ch. (Camb.) F.R.C. 4th ed. rev. New York: William Wood & Company, 1929.

ENTFÜHRUNG IN DIE GYNEKOLOGISCHE PRAXIS. By Professor Dr. Wilhelm Weibel. 4th rev. ed. Julius Springer, 1929.

OXFORD MONOGRAPHS ON DIAGNOSIS AND TREATMENT. Edited by Henry A. Christian, M.D., Sc.D., LL.D. VI—THE DIAGNOSIS AND TREATMENT OF ART. Russell L. Cecil, M.D., Sc.D. New York: Oxford University Press, 1929.

COMMON INFECTIONS OF THE FEMALE UTERUS AND CERVIX. By Frank Kidd, M.A., M.Ch. (Cantab.) (England), and A. Malcolm Simpson, B.A., M.D. (Cantab.), with additional chapters by George M.D. and M.S. Mayo, F.R.C.S. New York: Oxford University Press, 1929.

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